JAN -2 1914

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXI NO. 26 | SAN FRANCISCO, DECEMBER 27, 1913 | PER COPY, 25 CENTS

SYSTEM OF MT. WHITNEY POWER AND ELECTRIC COMPANY.

BY RUDOLPH W. VAN NORDEN.

FIRES AS A CAUSE OF SHORT-CIRCUITS ON HIGH VOLTAGE LINES.

BY J. C. CLARK.

PUBLIC UTILITY ACCOUNTING IN OREGON.

"PARTNERSHIP" VS. "PRINCIPAL AND AGENT" IN PUBLIC UTILITY RATE-MAKING.

BY J. F. DIX.

LIBRARY OF CONGRESS JAN 6 1914

MATERIALS ADVERTISED IN THIS ISSUE

Batteries
Edison Storage Battery Co.

Boiler Feed Water Treatment
Dearborn Chemical Co.

Cooling Towers
Chas. C. Moore & Co.

Electrical Instruments
Weston Electric Instrument Co.

Heating Appliances
Simplex Electric Heating Co.

Insulators
Hemingray Glass Co.
Pierson, Roeding & Co.
Pittsburgh High Voltage Ins. Co.

Insulator Pins
McGlauflin & Co.

Jet Condensers
Westinghouse Machine Co.

Lighting Fixtures
Benjamin Electric Co.

Machinery
Union Iron Works.

Motors
Century Electric Co.
Crocker-Wheeler Co.

Oil Burners
Leahy Manufacturing Co.

Piping
Pittsburgh Piping & Equipment Co.

Pole Line Specialties.
Pacific States Electric Co.

Pumps
Fairbanks, Morse & Co.

Push Button Switches
Bryant Electric Co.

Switches
K-P-F Electric Co.
Pacific Electric Switch Co.

Tools
M. Klein & Sons.

Transformers
Fort Wayne Electric Co.
General Electric Co.

Transportation
Southern Pacific Co.

Turbines
Pelton Water Wheel Co.

Wire (Trolley)
"Phono," Pierson, Roeding & Co.

Wire and Cable
Okonite Co.
Pierson, Roeding & Co.
Sprague Electric Works.
Standard Underground Cable Co.

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

Peirce Cross Arm Strap for service brackets—no boring, no weakening of cross-arms.

Peirce High Carbon Steel Pins are one piece forging—note the spring thread—no insulator troubles.

No. 35

No. 10

No. 25

Peirce Wall Brackets. 1, 2 and 3 points, cheap—stand heavy strains, are quickly attached. Straps prevent rocking on the wall.

PEIRCE POLE LINE MATERIAL and SPECIALTIES

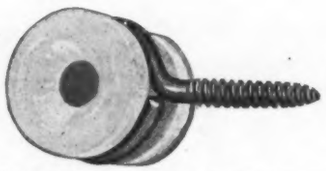
ALL STEEL---CHEAP---EFFICIENT

They save labor—They are all hot dip galvanized.

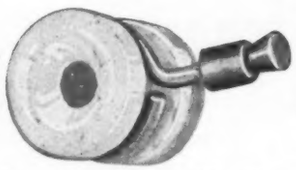
No 220

No. 230

Peirce Cross Arm, 2 and 3 point brackets, for service lines. No strain on cross arm pins, crossed wires obviated, quickly placed, cheaper and better than a buck-arm.



Peirce Knob Screw—all in one piece—the lineman's time saver.



Peirce Knob Bolt for attaching to brick and cement walls.

"If its Peirce, its satisfactory"

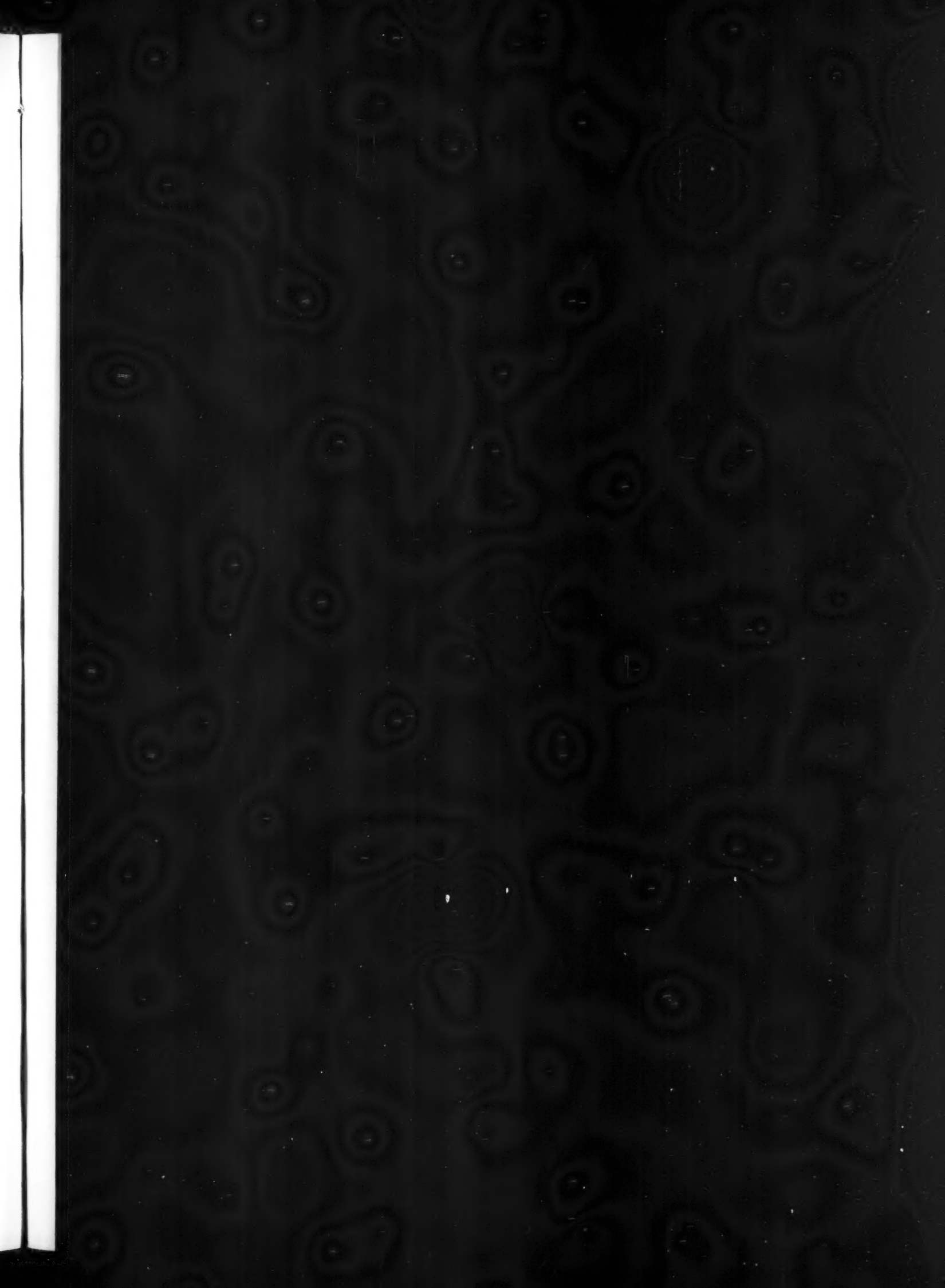
PACIFIC STATES ELECTRIC CO.

The Modern Electrical Supply House

Distributors for the Pacific Coast

SAN FRANCISCO OAKLAND LOS ANGELES PORTLAND SEATTLE

THE PACIFIC STATES ELECTRIC CO.
SERVES
THE PACIFIC COAST



©CLB295514

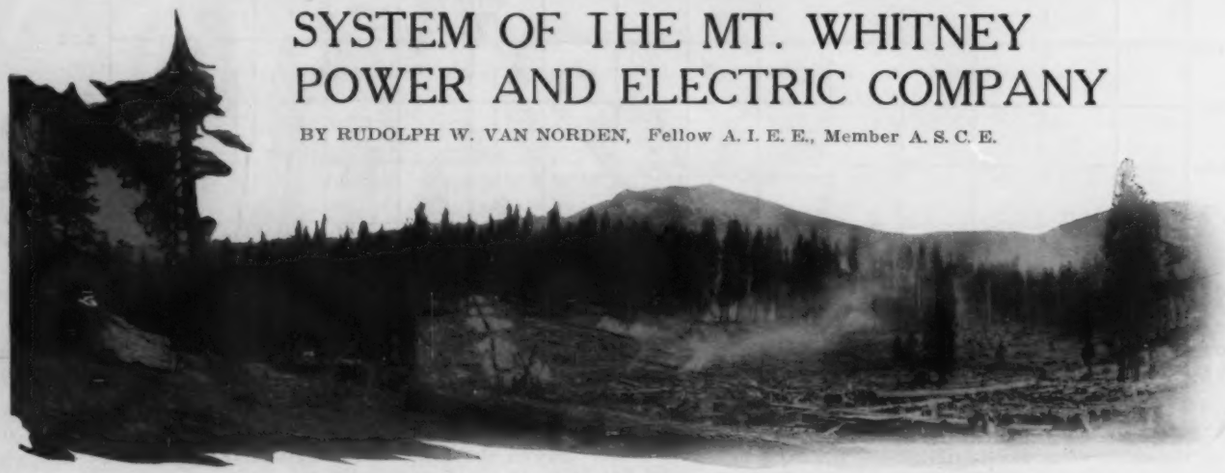
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXI SAN FRANCISCO, DECEMBER 27, 1913 NUMBER 26

[COPYRIGHT 1913 BY TECHNICAL PUBLISHING COMPANY]

SYSTEM OF THE MT. WHITNEY POWER AND ELECTRIC COMPANY

BY RUDOLPH W. VAN NORDEN, Fellow A. I. E. E., Member A. S. C. E.



Site of the Wolverton Reservoir, Showing Excavation for Concrete Toe of Dam.

The east half of the San Joaquin Valley of central California, is a vast plain of tillable, productive land, whose potential value manifests itself in the prolific outpourings of its hidden resources only by the application of a constant supply of water.

For many years this land was "dry-farmed." Wheat was the staple. The romance of the old life on these great ranches and the hardships of the droughts has been pictured by Frank Norris in "The Pit." But it has remained for the magic power of electricity to make possible the modern reality of quenching the thirst of this otherwise favored area.

A vast subterranean reservoir is so near the surface that deep-rooted trees can suck up the water and flourish through the long dry season. Electric power can be cheaply generated in the neighboring Sierras to pump water to irrigate a million acres. Here is the greatest and most desirable form of load that a power company could wish, and here the Mt. Whitney Power & Electric Company has built up an unparalleled business, based upon supplying electricity for pumping water. Thus is intensive cultivation converting the potential value of the great ranchos into the kinetic production of the small farm. The consequent rapid increase in population has in turn built up a market for industrial and domestic power, which supplements that needed for pumping.

The operations of the Mt. Whitney Power and Electric Company dates from June, 1899. The first plant represents almost a pioneer effort in the history of long distance transmission. But one or two plants had previously attempted to operate under so high a head. While the plant was small compared with the present day hydroelectric installations, it compared favorably in size with the few plants then in existence.

The idea of pumping the underground waters for irrigation was a conception originating with this project. Nowhere else had such a plan been considered feasible, and the small amount of pumping in this district by gasoline or steam was inefficient and costly, and canal irrigation was absurdly inadequate. The business to which the company first catered was therefore largely pumping and a small amount of lighting. It may be said that electrical irrigation pumping was developed by this system and was well established for many years before it had been adopted in other parts of the state by other electric power companies.

To study the growth from this first installation to that of the present, when there are four hydraulic power plants and one steam plant, and a network of transmission and distribution lines, aggregating 1262 miles, forms a most interesting illustration of how a great system is being gradually and conservatively built to meet the demands of a growing and prosperous population.

The increment of gain in the kilowatt hour output has been increased each year, the last year's increase amounting to 36 per cent. Both the gross and net earnings have increased in about the same proportion. This is readily shown on the accompanying chart in which the monthly kilowatt output is

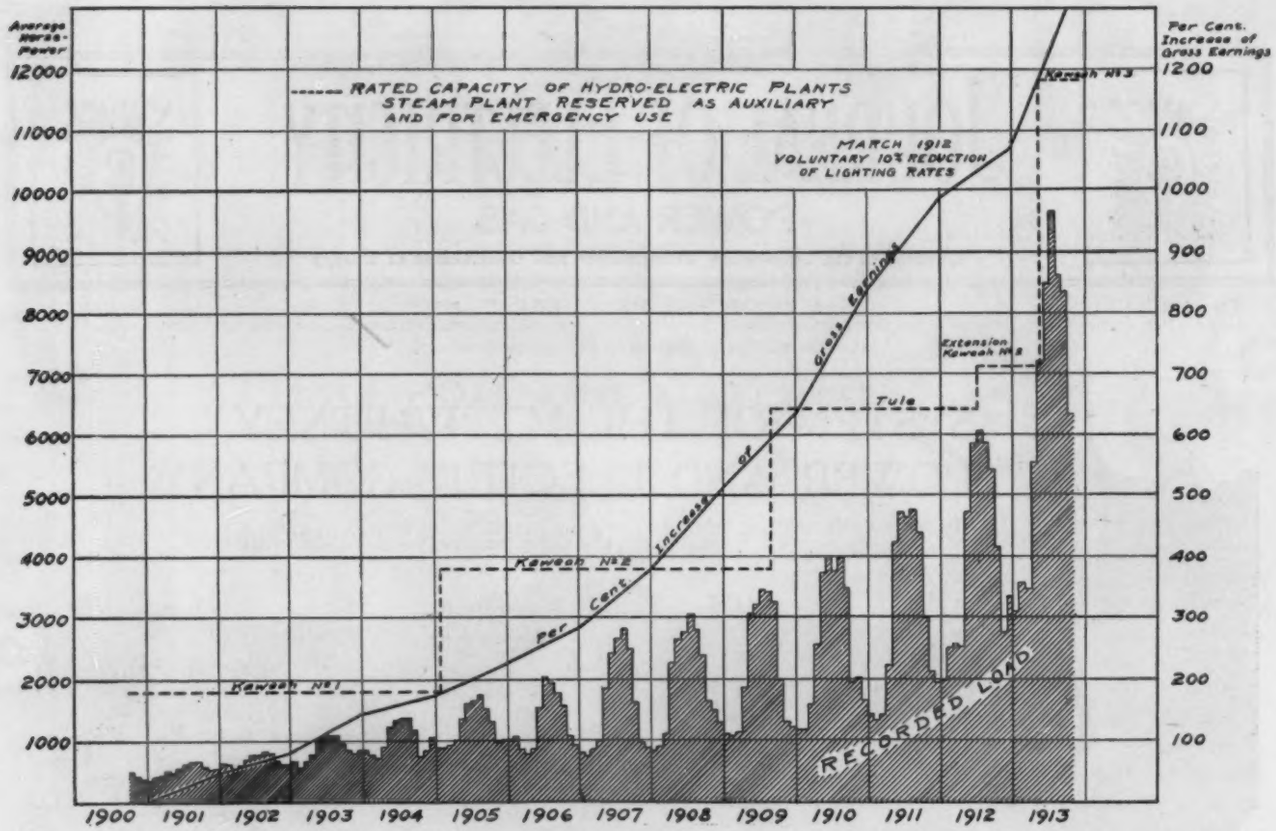


Chart Showing the Monthly Recorded Load in Terms of Horsepower, the Plant Capacity, and the Percentage of Increase of Gross Earnings With Reference to the Power Delivered.

graphically recorded. In this case the gross earnings in terms of percentage increase are also shown. A study of this chart will give a comprehensive understanding of the operations and business of the company. While but 8½ per cent of the territory reached by the lines of this company is as yet under cultivation, and hence requiring power, it is an interesting fact that for each mile of line there is installed 9½ h.p. in motors for irrigation pumping alone.

Hydrography.

The plants of the Mt. Whitney Power & Electric Company derive their water supply from two distinct watersheds of the western slope of the Sierra Nevada Mountains. These comprise the East, Middle and Marble Forks of the Kaweah River, and two forks of the Tule River. The former watershed is the more northerly, has an area of 250 square miles and its elevations range from 2600 to 12,400 ft. at its eastern boundary. The latter watershed has an area of 88 square miles and its elevations rise to over 10,000 ft. On the eastern boundary of the watershed there are several peaks approaching 15,000 ft., and Mt. Whitney, the highest of these and the highest peak in the United States outside of Alaska, exceeds this average. Their characteristics are similar in that the formation is largely granitic. The Kaweah watershed has more or less timber covering and much brush. Within its bounds is the Sequoia Giant Forest, which is famous for the number and size of its redwood trees. A characteristic of both watersheds is the rapid fall of the river-beds. This will amount to 300-400 ft. to the mile, and follows the general precipitous nature of the rugged country. Above 4000 ft. a heavy covering of snow is found throughout six months of the year, and at the extreme altitudes much snow remains the year round. The water flow during the melting time of the snow is necessarily large.

The precipitous canyons afford little possibility for the construction of reservoirs. A number of small natural lakes have been increased by the construction of dams, and these serve to augment the low water flow. One reservoir of importance, the Wolverton, will be described later.

Kaweah No. 1 Plant has its diversion in the East Fork of the Kaweah about 5 miles above its junction with the Middle Fork, where about 20 cu. ft. per second flow is available during the season of low water, storage being secured from several natural lakes in the high Sierras. These include Lady Franklin Lake, impounding 23 million cu. ft. of water, Silver Lake, Eagle Lake and Monarch Lake, whose estimated storage is 21 million cu. ft.

The diversion is at the outlet of a natural basin where a small granite masonry dam maintains the water level for the intake to the conduit. A 50 ft. tunnel through a jutting rock spur delivers the water from this basin to a timber flume. This flume has a capacity of 17 cu. ft. per second and is 30,000 ft. long, following the very precipitous mountain side of the south slope of the canyon.

In construction it follows the practice common in California at the time it was built. It has a section 3 ft. wide, and 2 ft. deep, and is supported on a timber structure, varying in height with the ground contour, from 6 to 50 or more ft. as the case may be. Redwood 1½x12 in. planks are battened with 1x4 in.

A Young Orchard Near Lindsay, Showing Pumping Plant Necessary for Its Development.

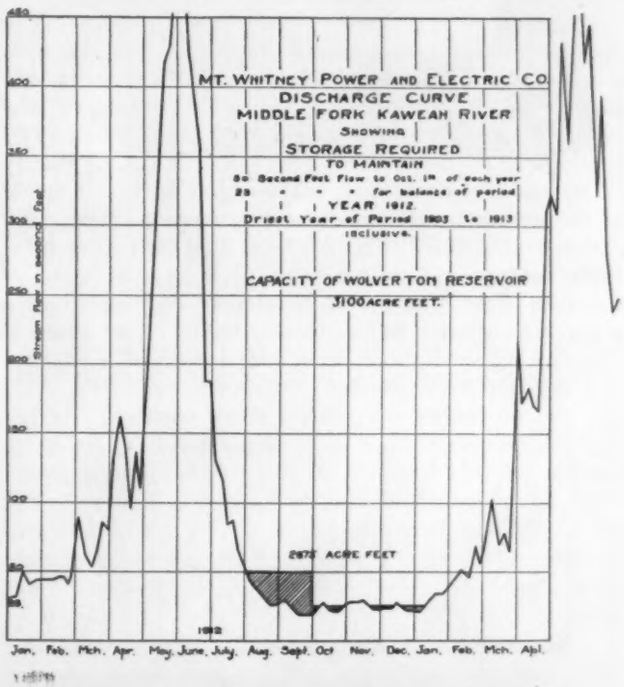
strips. The grade is rather heavy, being 20 ft. to the mile. Sand-traps are provided at frequent intervals, and at the lower end the water is emptied into a long sand box, 10x10 ft. by 200 ft. long, which has an apron spillway. From this the flow is carried into a wooden penstock, 6x8 ft. and 16 ft. in depth. The sandbox is provided with flush and overflow gates.

When this plant was constructed, it was not deemed advisable to take this flume out at a higher altitude, as the head on the power house was as great as was considered safe. Progress has since been made in the design and construction of all hydraulic apparatus. Above the intake a series of waterfalls make it possible to increase the head about 450 ft. To accomplish this a new canal is to be built on more modern and permanent lines to terminate directly above the present penstock. There is also an opportunity at this point for a regulating reservoir, a necessary and valuable adjunct with a plant of this kind. By means of this improvement the head on the plant will be increased to 1750 ft.

During a large part of the year a flow of 40 cu. ft. per second is possible from the East branch of the Kaweah River. As the present arrangement of the system compensates for lack of power over a short water period, by steam generation, it is thought advisable to design this new canal for the full flow of 40 cu. ft per second. With the aid of the regulating reservoir the power house may be rebuilt to handle as high as 60 cu. ft. per second, due to the daily variation in the load factor on the plant.

The output possibility of this installation can thus be increased at least fourfold. This improvement is contemplated for the near future.

Kaweah No. 2, the second plant to be built on this watershed, was completed in 1905. The diversion is in the Middle Fork, about one mile above its junction with the East Fork. This diversion was


MT. WHITNEY POWER AND ELECTRIC CO.
DISCHARGE CURVE
MIDDLE FORK KAWEAH RIVER
SHOWING
STORAGE REQUIRED
TO MAINTAIN
80 Second Feet Flow to Oct. 1st of each year
20 " " " for balance of period
YEAR 1912
Driest Year of Period 1903 to 1913
inclusive.
CAPACITY OF WOLVERTON RESERVOIR
3100 ACRE FEET.
2870 ACRE FEET
Stream flow in second feet
1912
Jan. Feb. Mch. Apr. May. June. July. Aug. Sept. Oct Nov. Dec. Jan. Feb. Mch. Apl.

A Mountain Meadow in the Kaweahs.

made at a natural dam site, between two granite ledges, and consists of a low granite masonry dam, whose maximum height is 8 ft. At the west end is the intake for the canal, in which are four hand-

View of the Flume Supplying Kaweah No. 1 Plant.

operated sluice gates, each 2 ft. 5½ in. wide by 6 ft. 6 in. high. The canal follows the hillside for a distance of 4 miles. Of this 3.15 miles is in concrete-lined ditch. The remainder is divided into several sections of timber flume. This conduit has a capacity of 80 cu. ft. per second. The ditch is 4½ ft. wide at the bottom, and 11½ ft. at the water surface, with a depth of 3½ ft. The grade is 5.28 ft. to the mile. Both bottom and sides of the ditch have a lining of concrete 3 in. thick, with a plaster coating to give a smooth surface and reduce friction. The flume is built of 1½ in. lumber, it is 5 ft. wide and 4 ft. deep and follows good standard California practice. At a number of points it is elevated on trestles. At the end of the canal line is a small forebay, being in reality an enlargement of the concrete lined ditch. This has a length of 270 ft., is 12 ft. wide and 9 ft. deep. At the lower end is a set of 5 sliding gates to allow the water to pass into the head of the pressure pipe line. The elevation of the intake of this canal is 1400 ft.

Kaweah No. 3 was placed in operation in May, 1913, and represents the latest development for this system. In location the power house is directly above the intake of the No. 2 plant, so that its discharge is caught behind the dam of No. 2, and immediately diverted into that canal. No. 3 plant derives its water from two diversions, one in the Middle Fork, about three-fourths of a mile above the junction of the Marble Fork, while the other is in the Marble Fork, about the same distance from the junction already mentioned. The water area available for this plant is practically the same as for the No. 2 plant, with the exception of a small amount of water, which may come in between the points of intake of the two systems.

The diversion in the Middle Fork consists of a concrete dam, having an Ogee section. This dam is a small affair, placed at a natural site in the bedrock of the stream. The intake on the south bank is formed by a heavy masonry wall extending to form the outer wall of the canal as well as a waste wier to return water to the river. Beyond this wall is a set of sluice gates, which controls the flow into the canal. These are protected by trash racks, and a sandbox.

The diversion from the Marble Fork is quite similar. The bedrock is largely, as the name would imply, of a light colored marble, and required little concrete to make a well designed and serviceable dam. Flow control is also similar to that in the Middle Fork. The canal is carried along the north bank of the Marble Fork to above the junction of the two branches. Here it is terminated by a sandbox and an overflow siphon, an interesting individuality which enters into the construction of this system. This terminus, which is a concrete lined box, acts as a head-box for a steel inverted siphon, which carries the flow of this canal across the Middle Fork, to a junction with the canal line from the Middle Fork diversion.

The waters of the two branches are thus mingled, and are then carried in a continuation of the Middle Fork conduit, which follows the east slope of the Middle Fork, to a terminus in a forebay res-

The Diverting Dam and Intake for the Kaweah No. 2 Canal.

ervoir for the No. 3 power house. This conduit line has a number of points of interest to engineers, as

it is quite unique in its design and method of construction, and represents the latest engineering effort of the company along this line. The ground surface followed by this conduit line is very rugged and uneven. In the construction of the conduit, a bench was first made. This was excavated partly by hand, and partly with the aid of a ¾ yd. Thew steam shovel. Wherever the excavation was such that a ditch section could be used, a berm was left for this purpose. These sections were lined with concrete 3 in. thick, in a manner similar to that of the No. 2 canal.

The total length of this conduit, including both branches is 25,000 ft. Of this, 5000 ft. comprises the section from the diversion in the Marble Fork, including the inverted siphon. The Middle Fork branch is 3300 ft. long. The remainder is the conduit from the junction to the forebay reservoir. The Marble Fork and main sections are built upon a grade of one foot in 1000 ft. Of this 6000 ft. is in concrete lined ditch, having a bottom width of 6 ft., a depth of 4 ft. and whose sides have a batter of 1:1. The remainder of this branch is in the slab bench construction, of which 12,700 ft. is on single slab construction, and 3000 ft. in double slab construction. Where the single slab is used half of the ditch is similar to the lined section, in that the inside slab has a 1:1 batter, and the concrete is formed on the ground surface, while the outside wall is a vertical slab, which is transported from the point of manufacture, and set in place. The double slab construction has both sides built of the portable slabs, while the bottom is laid on the ground surface.

That part of the main canal which receives its water from the diversion in the Middle Fork to the point of junction with the siphon from the Marble Fork, is built on a grade of 2 ft. in 1000 ft. This section consists of 3300 ft. of concrete flume, having a width of 6 ft. inside, and a depth of 3 ft. This flume is built of portable side slabs, but contains also a reinforced concrete bottom slab, and the entire flume is supported at the joints upon rubble masonry piers.

(1) The Diverting Dam and Intake Canal in the Marble Fork, Plant No. 3.

(2) Beginning of No. 3 Canal From the Marble Fork Diversion, Showing Gates and Trash Racks.

(3) Typical Section of No. 3 Canal, Showing Full Slab Construction.

The inverted siphon, which carries the flow from the Marble Fork diversion across the Middle Fork to

General View Looking Up the Marble Fork, With Middle Fork in the Foreground. No. 3 Canal Is on the Right. The Proposed No. 5 Canal and Pipe Line Is Located in the Center Background.

(1) Portable Concrete Mixer for Lining No. 3 Canal.
(2) Transporting Slabs.
(3) Full Slab Construction From the Middle Fork Intake, Before Forming the Pilasters.
(4) Same View After Pilasters Have Been Formed, and Flume Completed.

the point where it joins the main canal, is a riveted steel pipe 48 in. in diameter, and ¼ in. thick. Where this pipe crosses the bed of the Middle Fork, it is buried in a bed of solid concrete. When this work was constructed a second section of pipe was laid beside the present pipe in the concrete bed. This is to provide for a second inverted siphon, which shall be completed when the entire development of the No. 3 plant shall have been made. The object of the concrete bed over the pipe is to allow the flood waters of the river to pass over the pipe without any possibility of damage to the pipe, or of obstruction to the bed of the channel. The length of this inverted siphon is 1085 ft., and the maximum static head is 125 ft. At the lowest point there are outlet valves for the purpose of draining the pipe.

Wherever the ground surface offered a good support on the inner side, but not on the outer side, the bottom and inner slope were lined in the usual manner with concrete, but the outer wall of the canal was made of formed slab sections of reinforced concrete, which is another of the principal engineering characteristics of this line. All remaining sections of the line were built of formed concrete sections. In the making of the reinforced sections a space between the two forks was found of sufficient size and approximately level for a yard, in which the slabs used in the construction, could be made in large quantities. Gravel and sand were available in abundance in the nearby stream beds. A crushing plant was built with a large bunker capacity, and tracks for moving the sand, and removing the crushed rock from the crushers were built. Wooden forms were used to make the slabs, which were distributed throughout the slab yard, so that they could be readily handled when they had become sufficiently hard for transportation. The slabs are "L" shaped, the longer leg of the slab forming the side, while the shorter leg is an unfinished section of the bottom for the canal. The slabs were reinforced with Clinton wire fabric, having 4x12 in. spacing and No. 3 and No. 12 wire respectively, and they had additional reinforcement of two 5/16 in. twisted bars running lengthwise. The width of the slab at its upper edge is 3 in. This increases to 4 in. at the bottom. The length of the slab is 12 ft.

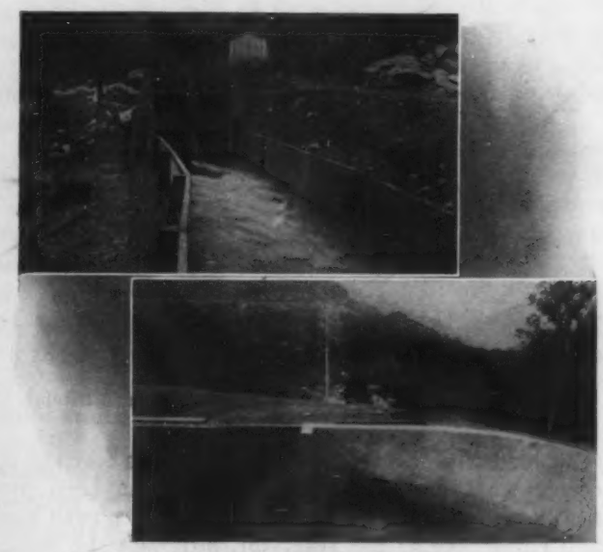
A track from the slab yard was built on an easy grade following the Marble Fork until the conduit grade was reached. This track was also continued in the opposite direction, crossing the river and up the further side until the grade of the main canal was reached.

Special double truck cars were used on which was a frame, and upon which could be loaded two slabs, straddling the frame. The portable derrick for lifting the slabs was also mounted on a car, and this followed the slab car to the point where it was desired to set the slabs down. In construction the slabs were carried to the lower end of the conduit line, and placed, the canal being built back toward the in-

take. A track was laid along the bottom of the canal, for the purpose of transporting the slabs and material and a gasoline locomotive was used. As the slabs were set in place, the bottom was filled in between the "L" branches of the slabs and finished with a fillet over the L extension. The reinforcement was not carried across, but extended well into the concrete bottom. Where a canal grade could not be economically made, the slabs were supported on piers, and in this case the bottoms are also formed slabs, and were properly reinforced to carry their weight, and that of the water in the canal.

The slabs were placed end to end, and the joint between them was made by means of a pilaster on the outside of the slab. In building the pilasters a foundation or base about 2 ft. square was first filled with concrete. A metal form was then set up, and the longitudinal bars of the reinforcement of each slab were bent outward, twisted together and allowed to extend into the pilaster. The pilaster form was then filled with concrete, and the point between the slabs was filled flush and smooth with concrete plaster.

All bends in the conduit line were, of course, made at the points of joining of the slabs, and the pilaster was simply formed to take up any angle between the ends of the slabs. This construction, while unique, has proven itself extremely serviceable in a situation of this kind where it is difficult to transport materials, difficult to handle heavy machinery, and concrete and labor are both high in cost. The over-all cost of this construction, including the benching, manufacture of the concrete slabs, and the finishing, was approximately $40,000 per mile.



(1) Control Gates in Marble Fork Diversion of No. 3 Canal.

(2) Entrance to Inverted Siphon Crossing the Middle Fork. The Siphon Shows in the Background, Where It Joins the Main Canal.

Along the line of this conduit there are five corrugated iron tool houses. These are placed at convenient points where cement may be stored, and where tools may be kept for the repair of the line. There are several sandboxes, which consist of a depression in the bottom of the canal, and a reinforced concrete box built out from the side, in which are placed two sluice gates. The bottom of the sandbox is 3 ft. below the bottom of the canal. A second and unique feature of this conduit line are the waste-way siphons. The flow of water over a weir is well understood, and is practically a fixed amount depending upon the head of the weir. In a system of this kind it is not desired to allow the head to increase very much above a certain point. To take care of all the water that may be necessary in the case of such a rise, would require many waste-ways of extreme length. For this reason the siphon was designed and these have been installed, where a large flow could be taken out of the canal with little increase to the head of water above the point where this flow commences. This is made possible by the familiar principle of the siphon. There are three large siphons, two at the end of the Marble Fork conduit, and the other at the forebay reservoir, and these have three parallel compartments, and are built of reinforced concrete. In action, the water after rising to a certain

Views on No. 3 Conduit.

(1) Typical Sandbox.

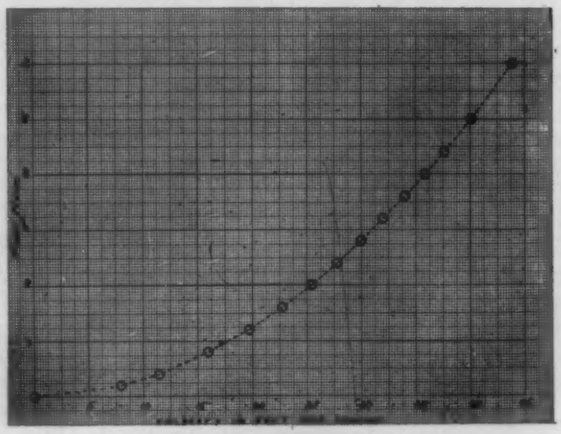
(2) Lower End of Concrete Flume, Showing Discharge Siphon Operating.

(3) Junction Between Concrete Lined Ditch and Slab Flume, Showing Deer Bridge Required by the U. S. Government.

point where it enters the siphon, flows over a weir edge inside of the structure. It then flows down a chute, which is also enclosed in the structure, into a bowl shaped receptacle. When this flow becomes

A Discharge Siphon in Operation.

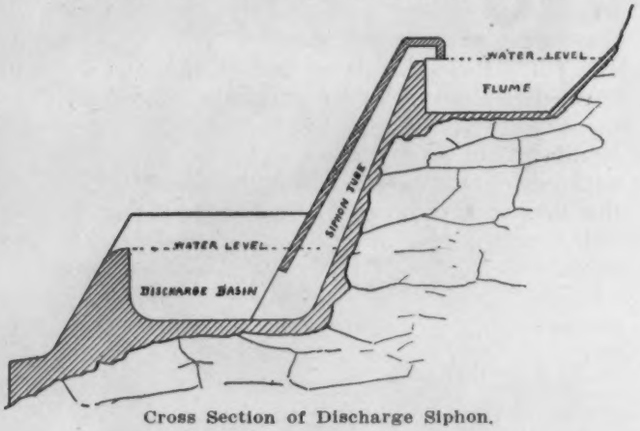
great enough to fill the siphon, the bowl acts as a water seal, thus cutting off the air supply into the bottom of the siphon. The water level already acting as a water seal at the top, completes the siphon action, and the flow from the canal is immediately increased to that which would be due to a head or draught equal to the height between the water level in the canal and the water level in the bowl at the bottom of the siphon. By this means the ordinary



Curve of Discharge From Siphon.

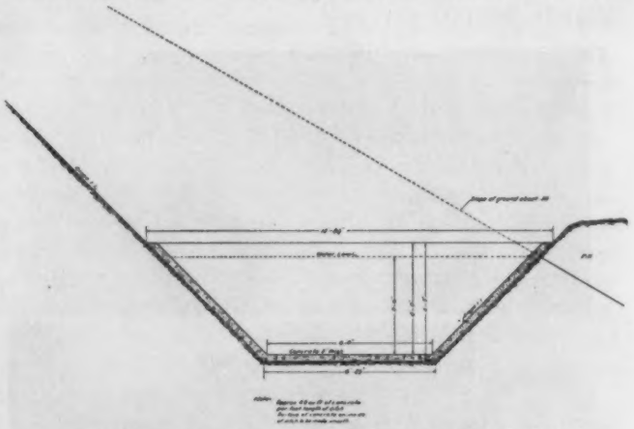
weir flow is increased to a great extent, and the siphon will take care of all the water which it may be desired to waste at this point. After the surface of the water in the canal is lowered to the point where the airlock at the top is destroyed, the siphon ceases to act. It is therefore, automatic in its operation. At intervals along the canal are six, one-compartment siphon spillways which are provided to discharge flood waters entering the canal from the adjoining hillsides.

A third interesting feature of this conduit system is the forebay reservoir at the terminus of the line. Originally the site was the point of a hill, which presented apparently no opportunity for a forebay reservoir. This point was leveled off until



Cross Section of Discharge Siphon.

the surface was approximately the shape of a crescent. It was then excavated, leaving an outer wall and having a depth of 22½ ft. This work which has now been about completed, while it has been costly, makes possible a reservoir which will have a capacity of 11½ acre. ft., and by this means the output of the power house may be greatly increased by operating much beyond the capacity of the canal line over

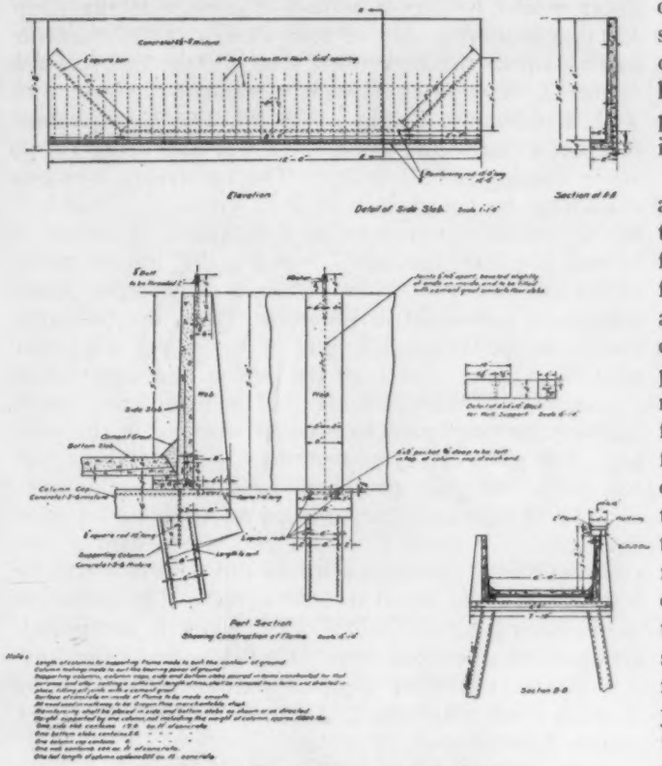


Typical Cross Section of No. 3 Concrete Lined Ditch.

peak loads. The total excavation of this forebay reservoir was 50,000 cu. yd., and this has been practically all in rock. The pipe lines to the power house will commence at the reservoir, although the present pipe is taken directly from the canal.

Kaweah No. 5 is a proposed new development between the intake of the Kaweah No. 3 system in the Marble Fork, and the Wolverton reservoir on a branch of the Marble Fork, there is a drop of over 3,000 ft. Of this drop the latter half is suitable for a power development, with a very short canal line. This project has been surveyed and work will be commenced during the coming year. It is proposed to divert the flow of the Marble Fork about 2½ miles

up stream from the present No. 3 diversion, and carry this flow in a reinforced concrete flume similar to that of the No. 3 system, to a point directly above the No. 3 intake. It is also possible to make a diversion at this altitude from the Middle Fork, and bring its water into this plant. The pipe line



Cross Section of No. 3 Slab Flume.

will be direct, and upon a heavy incline down the mountain side to the power house, which will be placed immediately above the present diversion in the Marble Fork. This plant will have an installation of 10,000 h.p.

The Kaweah No. 3 and No. 5 systems have been designed throughout by the company's engineering department, and the work of construction of the former system has been prosecuted entirely by the company's forces, under the direction of Mr. John Coffee Hays, the consulting engineer; Mr. H. A. Kluegel, chief engineer, and Mr. F. G. Hamilton, engineer of operation.

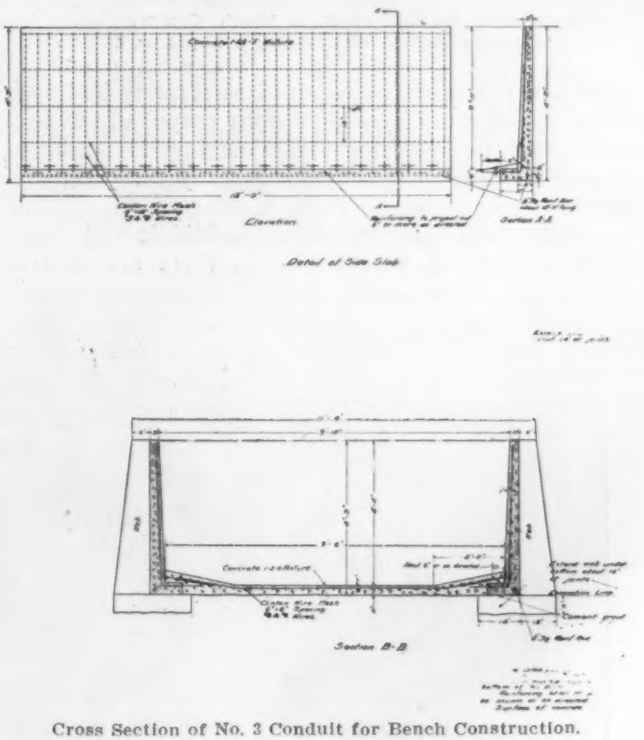
Storage Requirement.

The annual distribution of load upon the power houses of this system is peculiar, owing to the nature of the demand for power. As in all California watersheds, the maximum flow occurs during the period of melting snow in the high mountains. This diminishes through summer until September, when the flow becomes a minimum. It has already been explained in this article that this minimum flow is particularly severe within the watersheds of the Kaweah and Tule Rivers, for the reason that the ground reservoiring is small, due to the almost complete exposed rock surface, and very limited timber covering.

This company's principal load is pumping for irrigation. This commences in the early spring when there is an ample supply of water for power. The pumping continues until well into the autumn of the year, and overlaps a portion of the low water period. The irrigation load, however, decreases to a large extent some time before the period of minimum flow from the watersheds.

It has been the custom since the construction of the steam plant at Visalia to supply a certain amount of power during the early part of the low water season, to make up the amount necessary for load requirements, which could not be supplied from the hydraulic plants. This contribution from the steam plant has been relatively small, but nevertheless an important item for consideration.

In order to obviate the use of steam by the operation of the hydraulic plants, it has been necessary to supply storage in the mountains, to make up the flow of water necessary over and above the minimum flow available. In most California plants this storage flow would be required to cover the sag in the curve of natural water flow over the entire low water period, due to the conditions already outlined. It is not necessary in this system to maintain so great a flow over this minimum period, nor to continue this flow at its full initial volume. A very careful study of load curves with reference to the stream flow of the Kaweah River, and particularly with reference to the plants Nos. 2 and 3, and eventually No. 5, have resulted in showing that a flow from storage of 50 second ft. to October 1st, which can then be diminished to 25 second ft. for the balance of the low water season, will give sufficient power to satisfy the requirements of the distribution service over the most severe year of which there is any record. This provision will also take care of the future requirement covering these conditions for many years, assuming the



Cross Section of No. 3 Conduit for Bench Construction.

completion of Plant No. 5, and also prevent the necessity of operating the steam plant except as an emergency standby.

The storage capacity of the Wolverton reservoir is sufficient to supply a flow from storage of 50 second ft. for a period of 32 days, or a mean flow of 25 second ft. for twice as long a period. This will meet the demand which it is estimated will be necessary and will greatly increase the yearly kilowatt output of the hydraulic plants, with an accompanying increase in earnings without any additional outlay for plant capacity.

A Typical Section of Slab Bench Construction, Showing Method of Crossing a Depression.

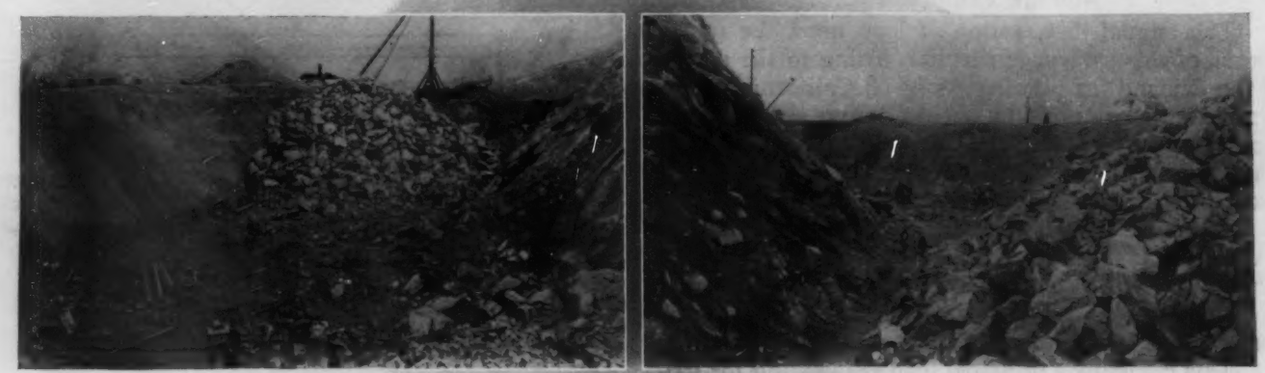
Wolverton Reservoir.—On the Middle and Marble Forks of the Kaweah River, there are also a number of small lakes, but these are not considered of value in connection with this system. The company has recently commenced construction of a storage reservoir on Wolverton Creek, which will be known as the Wolverton Reservoir. This basin, which has a heavy timber covering, while it is not of very great extent, will give sufficient storage to make up for the lack of power at low water. This reservoir has a dam of the rock filled type, 725 ft. long on the crest, 125 ft. wide at its widest point of the base, and with a maximum height of 90 ft. The down-stream face has a compound slope, the lower half being 1¼:1, while the upper half is 1:1. The up-stream face has a uniform batter of 1 ft. in 5 ft. vertical. This face has a rubble masonry lining 3 ft. thick, on which is placed a plank facing. Through the lowest point of the dam are two 28 in. diameter steel outlet pipes, which are embedded in concrete. There are two gate valves in each pipe line, one at the upper toe operated by a hand wheel on the top of the dam, while the other is at the lower toe, and is housed in a small masonry compartment to prevent freezing in the winter. The gate valves of the outlet pipes at the upper toe of the dam are protected by a trash rack, made of 3x½ in. flat steel bars, placed on edge, and spaced 2 in. centers. There is at one end of the dam a concrete spillway. The capacity of the reservoir will be 150,000,000 cu. ft., equal to 3430 acre ft. The elevation of the dam is over 7200 ft. This work is being constructed under contract by J. G. White and Company.

There is another available reservoir site on the Marble Fork watershed, this will be the object for future development.

Power Plants of Kaweah System.

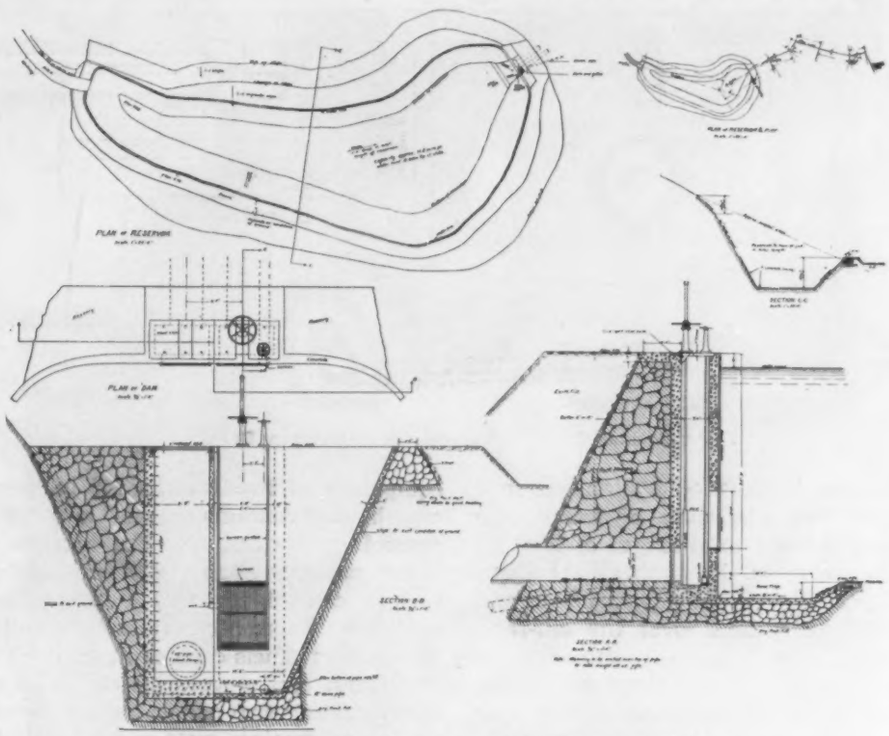
Kaweah No. 1 is served by a pressure pipe 3300 ft. long. The grade of this line is exceptionally rough and steep, and was considered at the time of its installation as a singularly difficult piece of work. There are no lateral bends and the slope has at places a grade of 100 per cent or 45 degrees. These slopes, however, constantly vary, so that there are many vertical bends.

The pipe has a diameter at the top of 24 in., and the thickness is No. 12 B. W. G., with a lap-riveted



Views From Opposite Directions, of the No. 2 Forebay Reservoir, Approaching Completion.

construction. As the pipe descends, the diameter decreases to 23, 22, 21, and finally to 20 in., of which diameter the last 1160 ft. is in lap welded pipe. The thickness at the power house is ½ in. The pipe line terminates with a section parallel to the power house building, in which are placed 3 cast steel branch fittings. From these, connection is made to each water wheel nozzle. For a distance of 400 ft. above the power house the pipe is anchored in a block of concrete, and throughout its length there are concrete anchors built into bedrock. The static head on this line is 1310 ft.



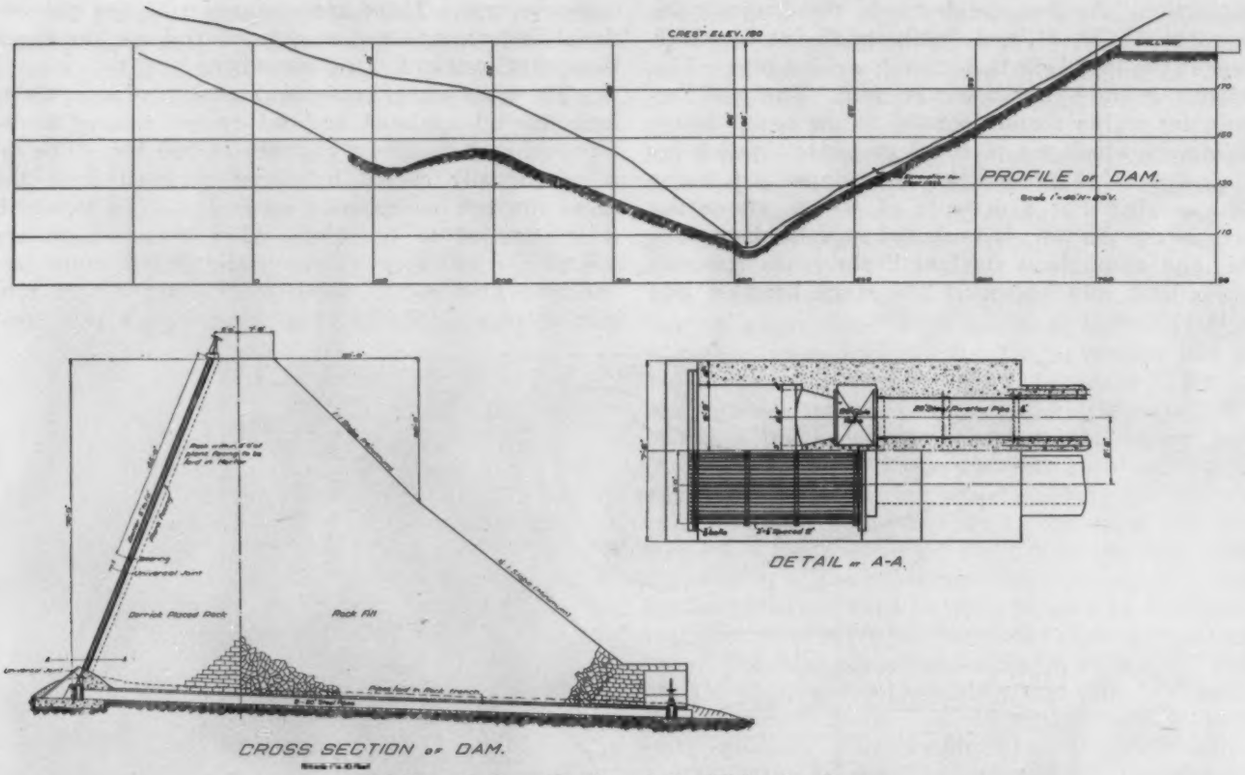
Plan and Cross Sections of No. 3 Forebay Reservoir.

The power house is on the south bank of the Kaweah River, about two miles below the junction of the Middle and East Forks. This plant, which was the first of the system, was built in 1899 and follows a practice of construction in vogue at the time. The power house building is 50 ft. long and 30 ft. wide, and is constructed of galvanized corrugated iron. Within the building are three main generating units and two exciter units. The generators are Westinghouse 3-phase, 450 kw., revolving armature machines, operating at 450 r.p.m. The water wheels are contained in a cast iron housing, and consist of a single overhung runner. Originally this was a Doble equipment, but has from time to time undergone various changes, when different makers have experimented with their particular type of bucket, in order to improve the efficiency of the apparatus. Two of these units are operated with straight nozzles, while the third is equipped with a needle nozzle. The exciters, which are rated at 15 kw., operate at 1050 r.p.m., and are driven by belts from pulleys on the generator shafts. Each exciter has sufficient capacity for all three generators.

The switchboard has six marble panels of Westinghouse type. These are equipped with the conventional instruments and remote control for the three General Electric K-2 oil switches.

The transformer equipment consists of four Westinghouse oil-insulated and self-cooled raising transformers, each having a capacity of 500 kw. The oil is additionally cooled by being pumped from the cases through an exterior cooling coil, from which it is returned to the cases. The transformers are wound for 440 volts primary, and 20,000 volts secondary. This is "Y" connected to give a high tension voltage of 34,600. Each transformer is housed in a separate small brick building and is mounted on a low structural steel car, which may be hauled out of the building, and placed upon a transfer car, which operates on a track passing the front of the transformer houses and parallel to the power house. In a separate building is a small machine shop and an ice plant. During the summer months the heat in this canyon becomes intense, and ice is made here for the convenience of those who live at the plant, as well as for the two other plants in this canyon. Incidentally, a small amount of ice is sold and distributed among the neighboring ranches, above and below the power plant. The discharge water from this plant flows into the Kaweah River, and is not again used.

Kaweah No. 2 Power House is across the river from the No. 1 plant, and about a mile below it. It is the second of the plants, having been constructed in 1904-5, and put in operation in February of the latter year. This is the only plant on this system that may be termed a low-head installation, the static head of the pipe-line being 351 ft. This pipe takes a direct course from the concrete headbox at the end of the canal line. There are five hand-operated sluice



Profile and Cross Section of the Wolverton Dam.

gates, 2 ft. 5½ in. wide by 6 ft. 6 in. high, set in a concrete wall, to control admission of water into the pipe. The pipe-line has a total length of 1000 ft., and a single diameter of 40 in. As at the No. 1 plant, the pipe parallels one side of the power house and is supported on steel "I" beams, over the tail-race. There are three branches in this final section of the pipe, which supply water to the three generating units, originally installed in the plant. The final section of the pipe, from which the connection to the last unit is made, has a diameter of 34 in.

The power house is a corrugated iron building, 59½ ft. long and 32¼ ft. wide and contains the generating units and switchboard only. Originally this building contained three main generating units. These each had a capacity of 500 kw. Two of these units have been removed, while the third still remains in use. This is a General Electric 500 kw., 2300 volt, 3-phase revolving field generator, operating at a speed of 450 r.p.m. It is direct-connected to a Victor Girard type turbine, controlled by an hydraulic-operated gate valve. One of the other units has been replaced by a new generating unit of 1500 k.v.a. capacity. This unit is of sufficient size to handle all of the water available in the canal system. The generator is General Electric, 2300-volt, 3-phase, operating at 720 r.p.m. It is direct-connected to a Pelton-Francis turbine, having a capacity of 2250 h.p. This water wheel has a runner 32 in. in diameter, and is equipped with a Lombard type "Q" governor.

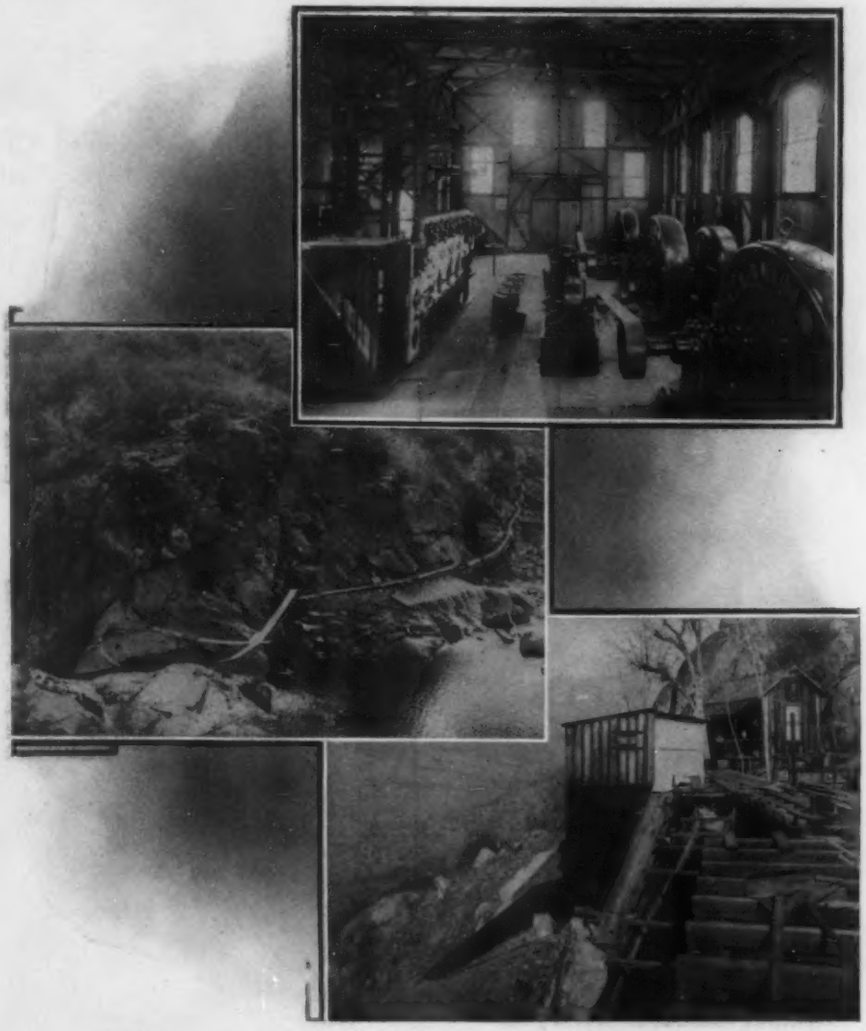
There are two General Electric 4-pole, 125 volt, 30 kw. exciters, which operate at 1050 r.p.m. These are direct-connected and driven by Platt Iron Works Girard type turbines.

To prevent shocks in the pipe line, there is an equipment of two Lombard 8 in. relief valves. The switchboard contains six marble panels, of which three control generators, one the exciters, and two are feeder panels. Each generator panel has mechanical remote control for two General Electric K-12 oil switches. There are 3 ammeters, and one volt meter. The exciter panels each contain two Thompson astatic ammeters, and 2 volt meters of similar type. On the remaining two panels are a General Electric polyphase integrating watt-meter and 8 controls for transformer switches. In a room at the rear of the switchboard is one 3-pole horizontal break Stanley rotary, 35,000 volt oil circuit breaker. These switches are mounted in slate tanks. Adjoining the power house is a long concrete building, in which are placed seven Stanley G. I. 350 kw. oil insulated raising transformers. These are wound for voltage of 2300 to 20,800, to be "Y" connected on the high tension side for the transmission voltage of 35,000. These transformers are mounted on low structural steel cars, which may be rolled out of the building on to a transfer car. The building is divided by transverse walls, so that each transformer occupies a cell of its own. Cooling is accomplished by circulating the oil from the transformers through a coil of 2 in. pipes, which is mounted in the tail-race. A water spray over this coil serves to carry away the heat of the circulating oil.

Kaweah No. 3 Power House has for the present a single pressure pipe line. It is proposed in the near future to duplicate this line, as there will be an additional supply of water available during the period of low water flow, due to the storage in the Wolverton reservoir. The present line receives the water directly from the end of the concrete flume, through a pair of sluice gates, and a set of trash racks. The line

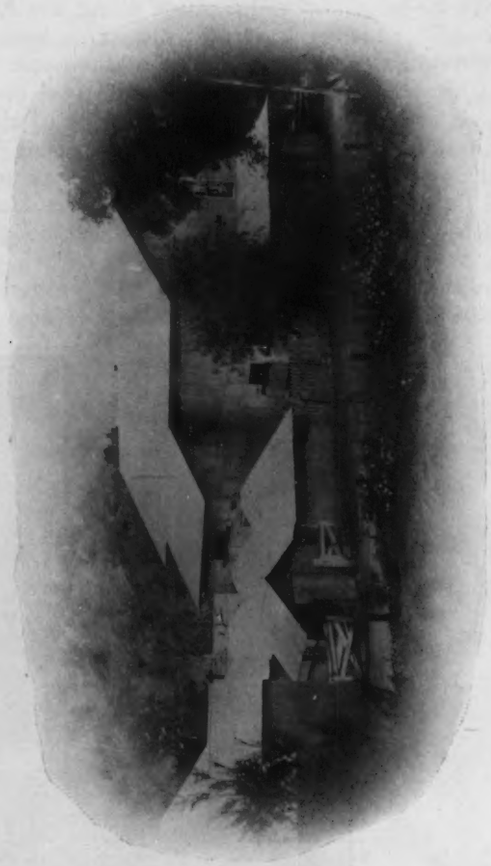
runs 839 ft. on a horizontal grade along the hillside and outside of the forebay reservoir. This horizontal section terminates at a stand pipe of the same diameter as the pipe. Beyond the stand pipe the line makes an abrupt turn to follow the slope of the hill to the power house. As soon as the forebay reservoir shall be completed, which will be about the first of the coming year, a part of this horizontal section of the pressure pipe 596 ft. long will be discontinued, and the intake will be from the forebay reservoir direct. The total length of the pressure pipe is 2589.93 ft. It is built throughout of riveted sheet steel, and has a diameter at the top of 42 in., with a thickness of plate of 3/16 in. As the pipe passes down the hillside the diameter is reduced to 40 in., then to 38 in., and finally to 36 in., at which size it enters the power house. The thickness at the power house is 5/8 in. The total static head is 776 ft. The pipe line is laid in a trench, and has a back filling of earth, and wherever there is a vertical angle, there has been placed an anchor of reinforced concrete. Manholes are provided at a number of points along the line. At the power house the pipe terminates in a cast steel Y. This is embedded in a block of concrete, carried to bedrock.

The power house is a reinforced concrete building 50x50 ft. inside measurement. It is divided by a transverse wall into a main operating room, a transformer and a high tension section. The main operating room is 50 ft. long by 34 ft. 4 in. wide. The transverse wall is of solid concrete 8 inches thick, and the building walls are of the same material and thickness. Running the long way of the operating room is a Cyclops hand-operated, traveling crane, with a capacity of 30,000 lb. The windows are ample, and are glazed with translucent wire glass set in metal frames. The building is fireproof. The two main generating units are arranged right and left-handed, so that the water wheel ends face each other. The main generators are rated at 1750 k.v.a., and deliver 3-phase current at 2300 volts, and have a speed of 300 r.p.m. The water wheels have each a single runner, are mounted on the end of the generator shaft, and are enclosed in a cast iron housing. The supply of water for each unit passes from each branch of the Y at the end of the pipe line, through hydraulically operated gate valves, and thence to the needle nozzles, with which the water wheels are equipped. These nozzles have auxiliary by-pass nozzles, which operate in connection with the main needles from the

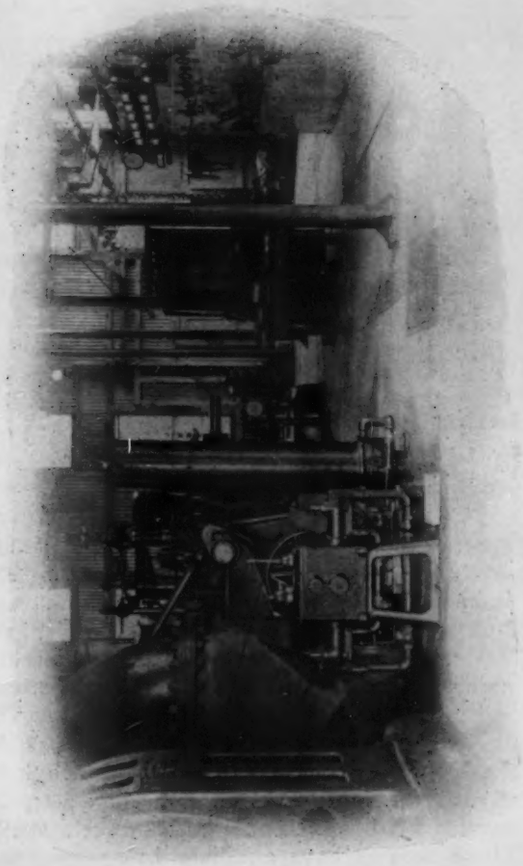


(1) Interior Kaweah No. 1 Power House.
(2) Intake Dam, Showing Tunnel and Wasteway Kaweah No. 1 System.
(3) End of Kaweah No. 1 Flume, Showing Sandbox.

Kaweah No. 3 Power House.



Kaweah No. 1 Power House.

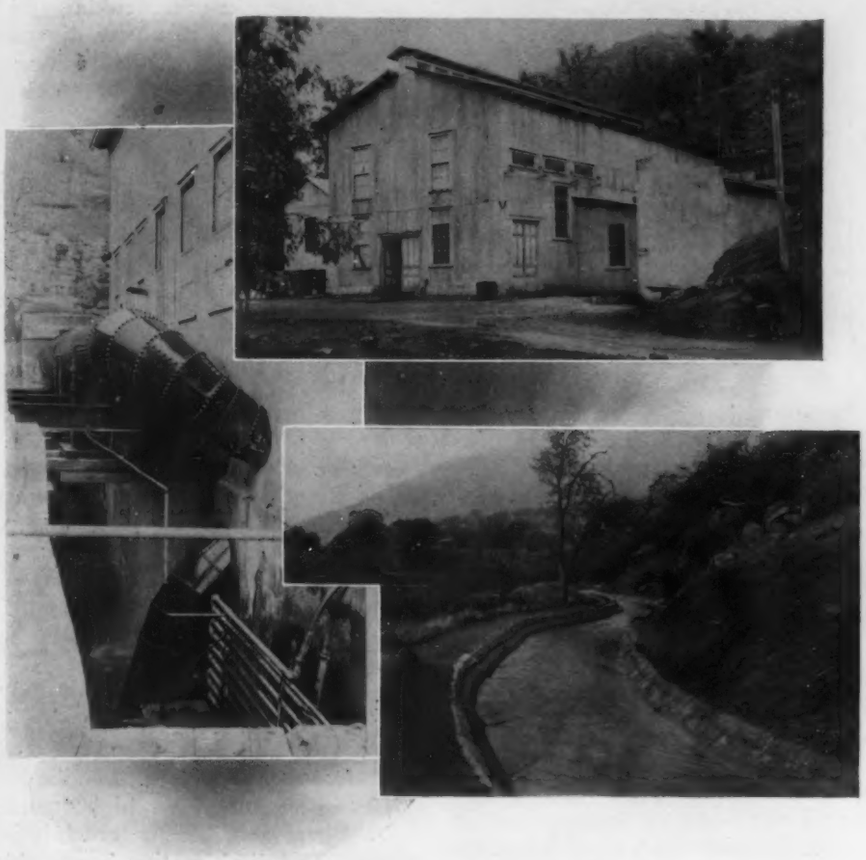


Interior Kaweah No. 3 Power House.

The Tule Power House.

governor. The action is such that as the water is shut off from the main nozzle, the by-pass needle automatically opens with a time element lag, to prevent shock on the pipe line, and then gradually closes for the purpose of saving water. Pelton automatic oil pressure governors are provided, and the entire hydraulic equipment was furnished by the Pelton Water Wheel Company, and was built under Doble patents. There is placed in the main pipe line, just outside of the building, as an additional safeguard against shock from sudden shutting off of water, a Lombard relief valve.

are equipped with volt meter, ammeter, wattmeter, power-factor meter, d.c. ammeter and rheostat control. The fourth panel contains a General Electric type T. A. voltage regulator, and the oil switch control and starter for the induction motor exciter set. The fifth panel controls the two exciter generators. Half of the remainder of the building contains the transformers, of which there are four. These are rated at 1250 k.v.a. The low tension winding is 2300 volts to 20,200 on the high tension side, the latter being star-connected for transmission at 35,000 volts. These transformers are oil-insulated and



(1) Kaweah No. 2 Power House.
(2) Receiver of Kaweah No. 2 Pipe Line; Also Showing Coils for Cooling Transformer Oil and Its Spray System.
(3) Concrete Lined Canal, Kaweah No. 2 Plant.

There are two exciter units. The generators of these are similar, each having a rating of 55 kw., and operating at 850 r.p.m. These supply direct current for excitation at 125 volts. One of these units is driven by an 82 h.p., 2300 volt, induction motor. This set has but two bearings, and is mounted on a cast iron bed plate. The second exciter is driven by a Doble water wheel, equipped with a hand-regulated needle nozzle. This is likewise a two-bearing set, mounted on a cast iron bed plate.

The switchboard in one corner of the operating room consists of five panels. The first controls a transmission line, and on it are mounted one graphic recording watt meter, one 2300 volt remote control circuit breaker, and two overload relays. The second and third panels control the generator output, and

water-cooled. The remaining section of the building is devoted to the high tension switching apparatus. This, for the present, consists of one 3-pole set of type "E" 35,000 volt Westinghouse oil circuit breakers. After leaving the high tension switch, the line passes through a set of inverted disconnecting switches, thence through choke coils, thence a second set of disconnecting switches, and then passes to the transmission line through 30 in. square openings in the wall of the building. These are fitted with two glass panes, having 6 in. holes at their centers. In the high tension compartment are one 50 kw. General Electric 2300 volt station transformer, and two 5 kw. transformers of the same make and size for local lighting and power service. Placed near the exciters is a small pumping set consisting of a 2 in. 2-stage

centrifugal pump, driven by a General Electric 5 h.p. 110 volt motor at 1800 r.p.m, and used for circulating transformer oil. A sound-proof telephone booth is placed against the end wall of the building near the switchboard. Upon the roof is mounted one

Interior Views of Kaweah No 3 Power House.

set of Westinghouse aluminum cell electrolytic lightning arresters.

The entire electrical equipment except when otherwise noted was furnished by the Westinghouse Electric & Manufacturing Company.

In the construction of the pipe line and forebay reservoir, a tramway was built, which starts a short distance below the power house, and after mounting the steep hillside for several hundred feet, meets the pipe line and then follows it to the top. This tramway is operated by a 2-cylinder, 3-drum Mundy hoisting engine, by means of a ⅞ in. steel rope. There is also at this point an air compressor plant consisting of two Giant compressors, driven by one Westinghouse 10 h.p. and one 20 h.p. induction motors.

The Tule River Power System.

The second and more southerly watershed and its accompanying power system is on the North and South Forks of the Middle Fork of the Tule River, the next river of importance south of the Kaweah. Its watershed has an area of 88 square miles above the points of diversion of the power canal and lies between the west slope of the ridge which separates the Kern River from the San Joaquin Valley. The drop of the stream beds is unusually rapid, and the watershed is rugged. A few small lakes in the upper regions of the watershed have not been improved for use with this system.

There are two diversions, one from each fork, each being but a short distance above the junction. The diversion in the North Fork at present consists of a small masonry dam at a point where the stream bed provides a natural place of intake for the canal. There is here a set of three sluice gates at the west end of the dam, and a wood flume commences immediately at the outlet of these gates. This diversion is being reconstructed by placing a concrete dam about 200 ft. below the present dam, and at a slightly lower elevation. From this new diversion a new flume is being constructed to the junction point. The distance from the present diversion to the junction with the main canal is 673 ft.

The diversion in the South Fork is formed by means of a low masonry dam, having a concrete spillway at the south end, and an intake similar to that at the North Fork diversion, consisting of a pair of sluice gates at the north end of the dam. Water diverted through these gates passes into a rectangular concrete lined ditch, built on a bench in the hillside. This joins a flume which forms the beginning of the main conduit. The distance from the South Fork intake to the junction with the North Fork flume is 577 ft.

The main conduit follows the north slope of the Tule River canyon to a point where the river makes a bend to the north. The ground surface followed by the conduit line is extremely rugged. The line itself is composed of 23,600 ft. of wooden flume, 11,206 ft. of concrete lined ditch, and 228 ft. of concrete flume. The total length of the conduit is 36,417 ft. or 6.9 miles.

The wooden flume is of the conventional type found throughout the mountains in California. It is 4 ft. wide and 3 ft. deep, and is laid on a grade of 2 ft. in 1000. It is built of pine lumber, and in many cases is supported on high trestles.

Where possible the conduit is in ditch, concrete lined. The ditch section has a width of 4½ ft. on the bottom, 10½ ft. across the top, and is 3 ft. deep. The grade of the ditch sections is one foot in 1000, or half that of the flume sections. The concrete lining has a thickness of 3 in., of which ½ in. is a plaster covering.

In the line is one inverted siphon 879 ft. long of lap riveted steel pipe ⅛ in. thickness and 36 in. in diameter. The maximum head on the siphon is 120 ft. The several sand-boxes, consisting of enlargements in the concrete lined ditch section in which the bottom is somewhat lower than the bottom of the incoming ditch, are provided with sand gates.

At the terminus of the canal line is a small regulating reservoir with a capacity of 175,000 cu. ft. and varies in width from 12 to 125 ft. The length is 302½ ft. and the side slopes are ½ to 1. The lining of this reservoir is heavier than in the ditch sections, being 8½ in., which includes the plaster coating. At the entrance of this reservoir is a sand-trap 12 ft. deep.

The pressure pipe line to the power house enters the forebay reservoir, and is carried from the reser-

(1) South Fork Diversion Into the Tule Power System Canal
(2) North Fork Diversion Head-Gates.
(3) New North Fork Diversion, Showing Concrete Dam.
(4) North Fork Diversion and Dam.

voir directly down the hillside to the power house. This pipe has a diameter of 30 in. at the top, with a plate thickness of No. 11 B. W. G. Ths diameter decreases to 28 in., thence to 26, and finally enters the power house at 24 in., with a thickness of plate of 9/16 in. The total length of the pipe is 2814.8 ft. The static head is 1130 ft. Throughout, the pipe is laid in a trench, and is covered with a back filling of earth.

Tule Power House.

The Tule plant was built in 1908-9, and commenced operations in September of the latter year. The power plant is in two buildings, in which the generators and transformers are contained in the larger; and the high tension switching apparatus, in the smaller building. Both are steel frame structures, and have reinforced concrete curtain walls. The main building is 39x30 ft., and has a corrugated hip roof with monitor running the full length. Against one side of the building is a lean-to addition, which increases the width of the building by 14 ft. 9 in., in which are placed the transformers. There are two main generating units. These each have a capacity of 1000 kw. They are General Electric type A. T. B. 2300 volt, 3-phase revolving field machines, operating at 514 r.p.m. The water wheels consist of a single runner mounted in cast iron housing, on the end of the generator shaft. These are Doble wheels, and are rated at 1800 h.p. each. Automatic needle bypass nozzles form a part of the equipment, and these are controlled by Lombard type K governors.

The pressure pipe enters the building below the floor line, at the center and in the rear. It immediately branches through a cast steel Y, and on both ends of this branch are two hydraulic-operated gate valves. From these the nozzle fittings are carried into the water wheel housing. The discharge from the water wheels passes through tunnels to a point outside of the building, from which it is led into a ditch, which carries the water up stream in reference to the direction of the Tule River, for a distance of about ½ mile, and there discharges into the river. This was necessary on account of the use of water by other appropriators. The power house is therefore, not placed at the lowest possible point with reference to the river.

Of the two exciter units the generators are General Electric 35 kw., 125 volt, d.c. machines, which operate at 1200 r.p.m. One of these exciters is driven by a 60 h.p. General Electric induction motor, while the other has a Doble water wheel, overhung at one end of the generator shaft.

The switchboard is placed at the center of one side of the building, facing the generators, and opposite to the incoming pipe line. This equipment, furnished by the General Electric Company, is in polished black slate in 5 panels, the first being devoted to the control of the exciters, mounting Thompson astatic instruments and rheostat controls, and a totaling polyphase watt meter. The second panel has a General Electric type T. A. voltage regulator. The third and fourth panels are devoted to the generator control, and contain ammeters and volt meters, and

Interior of Tule Power House.

time limit relays, together with power factor indicators and watt meters. The fifth panel controls the transmission line switches, and has one indicating watt meter, two time limit relays and remote control for two transformer switches. This panel also contains a synchroscope.

Views on Tule Canal System.
(1) Junction of Concrete Lined Canal and Wooden Flume.
(2) Enlarged Section of Canal, Containing a Sandbox.
(3) View Looking at Flume From Below.

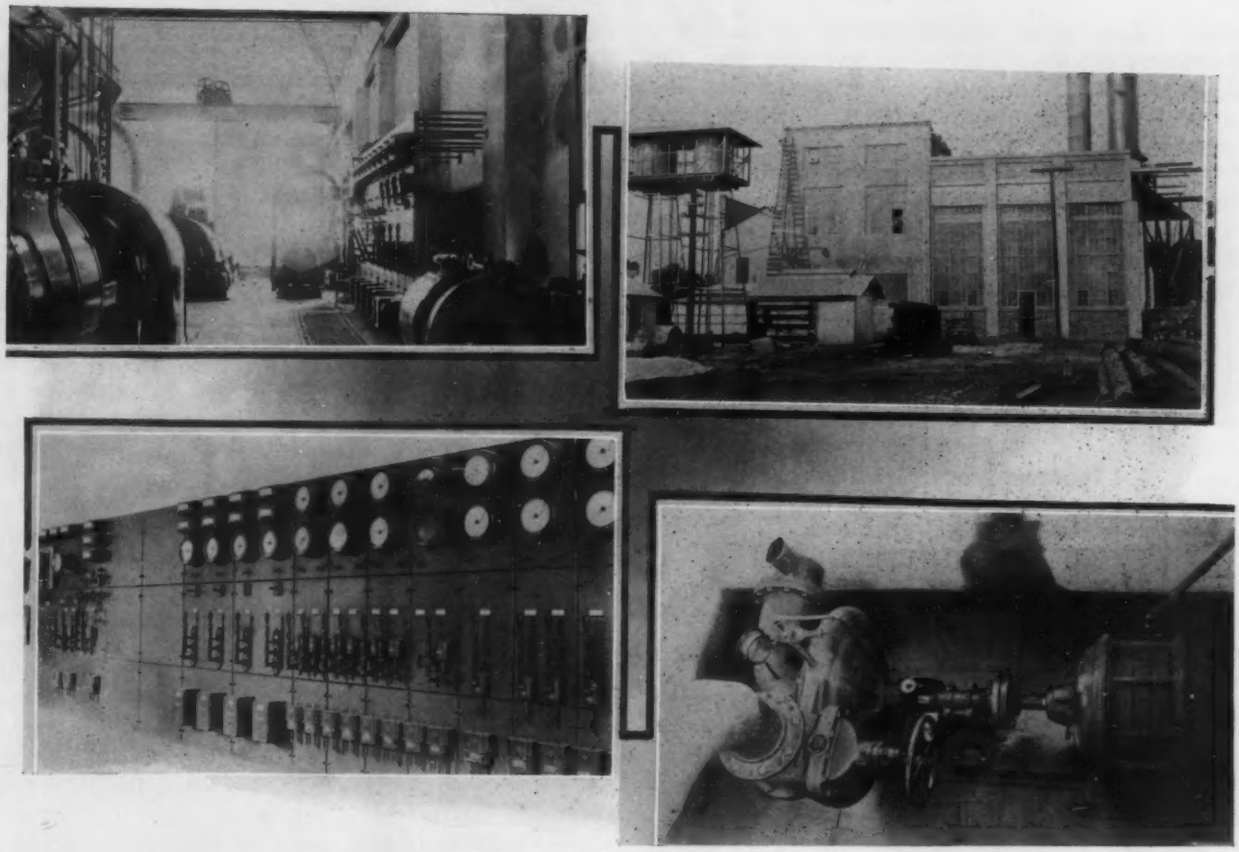
The transformers, which are separated from the main room of the power house by a concrete wall, consist of two banks of 3 General Electric, 400 kw. water-cooled transformers, wound for a primary voltage of 2300, and a secondary voltage of 20,400, and are delta connected on the low tension side, and star connected on the high tension side, to give 35,000 volts for the transmission line. In the second building, which is devoted to the high tension switching apparatus, there is one set of 35,000 volt General Electric aluminum cell lightning arresters. This switch house is arranged with cells in two groups for three incoming high tension lines from the transformers, and one outgoing line.

Disconnecting switches are provided and one main line 35,000 volt Kelman circuit breaker is installed here. On a pole structure outside of this building is a set of line disconnecting switches.

Visalia Steam Plant.

For seven years, after commencing operations, this system depended entirely upon the power received from its hydraulic stations. As the business and load increased, it was found advisable to install a steam auxiliary plant, both for the purpose of supplying power in case of emergency, where there might be an accident in the transmission system, or during periods of extreme low water in the mountains. Work was commenced in 1905 on a steam station in the city of Visalia, and this plant was completed in August, 1906.

The first installation had a single generating unit of 1000 kw. capacity. In 1912 the capacity of the plant was increased by the addition of a second steam turbine and additional boilers. During 1913 a further increase has been made by the addition of a third



Views at Visalia Steam Plant.
(1) Turbine Room, Looking Toward New Addition. (2) Rear View of Power Plant, Showing New Construction.
(3) The Switchboard. (4) One of the Water Supply Pumps in the Bottom of a Pit.

turbo-generating unit. The transformer substation for Visalia is also at this point.

The plant consists of two two-story structures. One of these is the transformer station, and contains the high tension switching apparatus. On the lower floor of this building are housed the transformers. This section is 43½ ft. long by 24½ ft. wide. The Visalia distribution has both 2-phase and 3-phase circuits, so that the transformer connectons are made to supply this demand.

Of the transformer equipment there are four Allis-Chalmers 500 kw. transformers. One of these is a spare for use in case of emergency. These transformers are wound for 19,050 volts on the primary side, and 2300 on the secondary. They are star-connected on the high tension side for the 34,000 volt transmission connections. On the low side they are delta-connected with a center connection in one of the transformers, in which is inserted a 50 kw. booster. This is for the purpose of supplying a 2-phase secondary circuit. There is a second set of four 350 k.v.a. Westinghouse transformers, one being a spare. These are star-connected on the high tension side, but on the low tension side are delta-connected to give three single-phase circuits. This is for lighting service in the city of Visalia. The Allis-Chalmers transformers are oil-immersed and water-cooled. From the Westinghouse transformers the oil is circulated through an old transformer tank. In this tank is a coil of 30 turns of 1 in. copper pipe, and the cooling water is circulated through this coil. By this means the oil temperature is not allowed to go above 105 degrees F. in winter, or 110 degrees F. in summer. A 3 h.p. 3-phase induction motor drives a 2 in. Price centrifugal pump. This rig is used for circulating transformer oil.

To accommodate the increased capacity of the steam station, there are being installed three 2500 k.v.a. Allis-Chalmers water-cooled transformers, wound for 33,000 to 2200 volts and to be delta-connected on both sides.

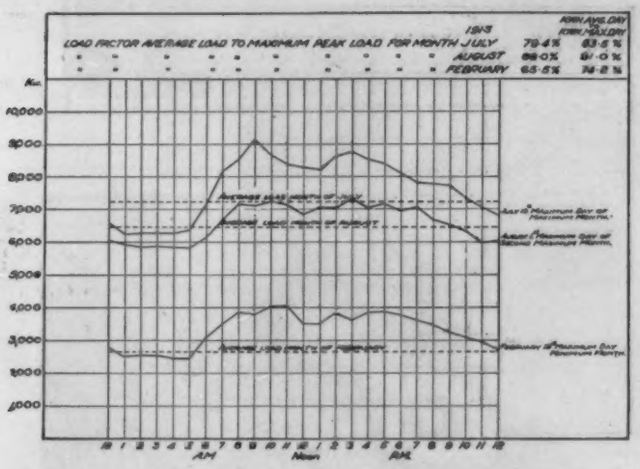
Each of the two 6.6 ampere mercury arc rectifiers has a capacity of 75 lights, and supplies the current for the street lighting system in Visalia. In connection with these rectifiers are two General Electric arc transformers with a primary voltage of 2200 and a rectified voltage of 6750. The rectifiers contain both heating and cooling coils and a small motor for circulating oil.

A synchronous condenser was found necessary to improve the load factor on the system, and is of great value in that connection. This machine is a General Electric 3-phase, 500 kw., 2300 volt, synchronous motor, operating at 450 r.p.m., belt driven by a 50 h.p., 2200 volt General Electric induction starting motor. By the use of this condenser it is possible to raise the power factor on the system about 20 per cent and bring its value at the power houses to about 90 per cent. There is here also a standard General Electric 7 in. oil filter and purifier, having a capacity of 6 gal. per minute.

On the second floor over the transformer room

are two compartments, one containing the bus lines, and 2300 volt, low tension oil switches from the generator feeders, the other room containing the 34,000 volt incoming and outgoing line switches and disconnectors.

The two incoming high tension circuits enter through roof insulators. The third circuit leads to the transformers underneath. Of the incoming circuits, one is from the power plants; the second is a circuit connecting into the network, known as the


LOAD FACTOR AVERAGE LOAD TO MAXIMUM PEAK LOAD FOR MONTH
1913
JULY 79.4% 83.6%
AUGUST 69.0% 81.0%
FEBRUARY 65.5% 74.2%
KWH AVG. DAY
KWH MAX. DAY
M.t WHITNEY POWER & ELECTRIC CO.

Typical Load Curves, Mount Whitney System.

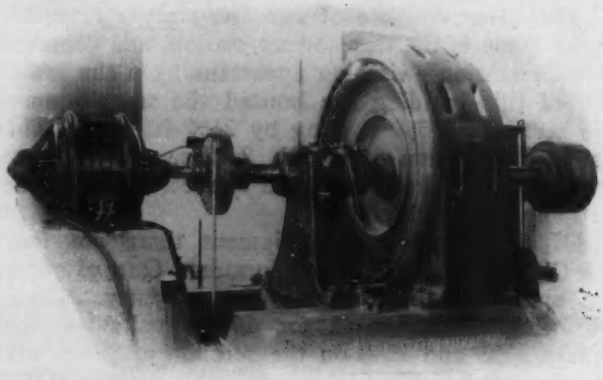
west side line, and leaves this station, passing southward to Tulare, Tipton and Delano. The incoming lines pass through disconnectors, thence through a set of General Electric K-21 oil circuit breakers, thence through a second set of disconnectors to a bus line. The oil circuit breakers and connections are all mounted between concrete barriers. The conductors are ¾ in. copper tubing. Upon either end of the bus line are disconnectors, and from these the circuit is carried in one instance, through a set of circuit breakers similar to those described, and thence to the outgoing transmission line. The transformer connections are made in a similar manner from the other end of the bus line. This room will be extended to accommodate new equipment in the near future, as the requirement of the business may dictate.

The main building contains in the front part, a machine shop on the first floor, and sleeping rooms for operators on the second. In the rear of this building is the generating room, which is on a level with the second floor. The old generating equipment consisted of one Westinghouse-Parsons turbo-generator, having a capacity of 1000 kw., and operating at 1800 r.p.m. The second machine is a General Electric Curtis 2-stage turbo-generator, having a capacity of 750 kw. at 80 per cent power factor, and operating at 3600 r.p.m. The turbine is equipped with mechanical valves. Both of these machines deliver 3-phase current at 2300 volts. The third turbine occupies a continuation of the old generating room space. This continuation, however, is in a new type of building, having a reinforced concrete frame, with brick curtain walls. It is proposed to increase the width of the old generating room to correspond with the new section, and to make this entire part of the building uniform. The new section is 36 ft. long and the outer end has a temporary metal lath and plaster wall, so that a still further extension may be made. The present total length of the generating room is 100 ft. The new turbine is a Westinghouse-Parsons double flow type, and has a rated capacity of 5000 k.v.a. All of the main unit steam equipment operates at a steam pressure of 175 lb. per sq. in., and all of it is condensing.

The exciters consist of one General Electric 50 kw. 4-pole and interpole machine, operating at 1200 r.p.m., driven by a General Electric induction motor of 75 h.p. capacity. This set is mounted on a cast iron base, and has three bearings. The second exciter set consists of a Curtis turbo-generator operating at 3600 r.p.m. Its capacity is 25 kw., and the generator has two poles, with interpoles. The turbine operates non-condensing.

The switchboard for the plant is placed about the center of the generating room, close to one wall. It is in 9 panels, of which the first controls the exciters, the second has a T. H. voltage regulator, also the remote control switch connections for two transformers. The third panel contains the control for the new 5000 k.v.a. generator. The fourth and fifth control the first two turbo-generators, and the last four panels control three 3-phase 2300 volt circuits, and one 2-phase 2300 volt circuit. Operating throughout the length of the generating room is a Whiting hand-operated traveling crane, having a capacity of 20 tons.

Of the auxiliaries on the main generator floor there is one Worthington tandem vacuum pump 6x12x12 in. and one Wheeler opposed vacuum pump 6x14x10 in.

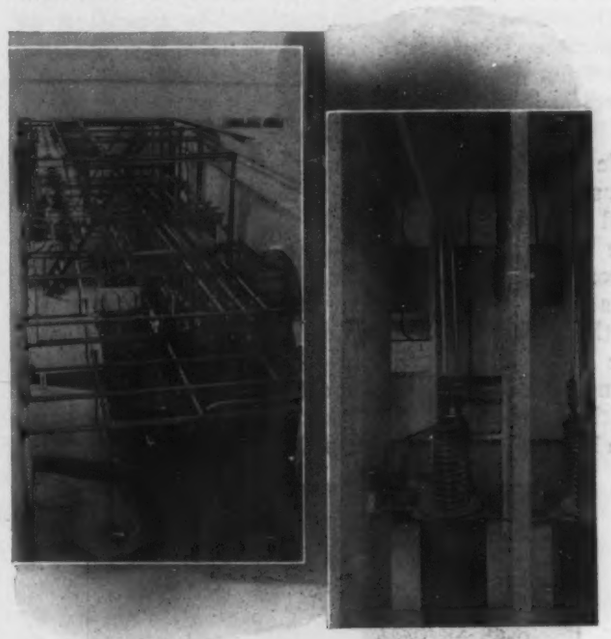


Synchronous Condenser, Starting Motor and Magnetic Clutch at Lindsay Substation.

Adjoining the generating room, parallel to it, but on the ground floor, are four Stirling Class "Q" 302 h.p. boilers. These each contain 273, 3¼ in. tubes, three 42 in. steam drums, and one mud drum of the same size, each equipped with two Hammil oil burners. Placed in an L in the new section of the building is one Stirling boiler, having a capacity of 604 h.p. This boiler contains 440, 3½ in. tubes, three 42 in. steam drums and one 48 in. mud drum, and has three oil burners. Three more boilers similar in type and size are ordered and are to be placed in the near future.

Of the auxiliaries there are two Smith-Vaile steam pumps for fuel oil. These are 6x4x6 in. In this connection there is a Berryman-Patterson feed water

heater, used as an oil heater. Each turbine has its own condenser. The 750 kw. machine is equipped with a Wheeler jet condenser. The 1000 kw. turbine has a Worthington surface condenser, containing 3600 sq. ft. of cooling surface. The new 5000 k.v.a. turbine is equipped with a Worthington-Leblanc condenser. The feed water pumps consist of two Worthington 10x5½x10 in., and one Smith-Vaile 10x5x10 in. steam pumps. There is one 2-stage 2 in. Worthington centrifugal pump, driven by a 3-phase 5 h.p. General Electric motor, which drains the surface condenser. There is one G. W. Price 10 in. centrifugal pump, driven by a 50 h.p. Westinghouse induction motor,



(1) Rear of Switchboard, Lindsay Substation.
(2) A Pair of 35,000-Volt Circuit Breakers, Showing Cells and Bus Lines.

which supplies water both to the surface condenser and to the cooling tower. For the jet condenser a 25 h.p. Kerr steam turbine, operating at 1500 r. p. m. is connected to an 8 in. Wheeler centrifugal pump. The circulating water is pumped from wells into a large reservoir, from which it is drawn for use. The heated water is returned through a spray system to this reservoir, and is allowed to cool by the effect of evaporation. The loss by evaporation is made up by additional pumping. This makeup water is handled by a G. W. Price 5 in. centrifugal pump, driven by a 10 h.p Westinghouse induction motor. The last pumping installation in the power house consists of a pair of Terry steam turbines direct connected to Platt Iron Works No. 4, 3-stage centrifugal pumps, operating to 520 ft. head, at 2800 r.p.m. These supply feed water to the new boilers.

Water for this plant is obtained from six wells, which have an average depth of 80 ft., and a diameter of 12 in. There are two pumping rigs, each pumping from three wells. In each pump house is a high duty 8 in. centrifugal pump, driven by a 25 h.p. induction motor at 900 r.p.m.

A third pumping unit consists of two 2 in. Price centrifugal pumps, driven by 3 h.p. 2200-volt motors, which is used exclusively for station supply, sealing the turbines, etc. At one corner of the property, reached by a spur from the line of the Southern Pacific are two steel fuel oil tanks, having a capacity each, of 750 bbl., and a third tank, with a capacity of 3000 bbl. There are also two elevated water tanks, each with a capacity of 3000 gal. for general station supply.

The system for cooling circulating water, which has been in use at this plant, has been of the gravity tower type. In many respects, this has not proven satisfactory, and recently a new spray system has been installed. Adjoining the power house, and within the company's property, a large rectangular pond was constructed by excavation. This has a length of 168 ft., a width of 120 ft., and is about 3 ft. deep. The pond has a lining of reinforced concrete. Over the pond are mounted several groups of spray nozzles, through which the circulating water from the condensers is discharged. The nozzles are so designed and located with reference to one another, that the water issues from them in the form of fine spray, which assists in the evaporation, and hence the cooling of the water below the temperature of the air. This system is designed to cool 10,000 gal. of fresh circulating water per min., reducing the temperature from that of the condensed discharge of 110 degrees to 85 degrees F. when the surrounding air is 100 degrees F., with a 25 per cent relative humidity. This is the first large installment of a spray pond cooling system on the Pacific Coast, and is expected to give favorable results notwithstanding the extreme climatic conditions of the San Joaquin Valley. It has been designed and installed by Charles C. Moore & Company, Engineers, of San Francisco, in connection with other extensive construction work, which they have recently done on this plant.

Power Output.—The power output of the four hydroelectric plants and the steam standby station, in terms of horsepower, has a maximum aggregate based on the ratings of installed generating machinery of 19,600 h.p. The overload capacity for which the hydraulic systems and all of the machinery is designed, gives a maximum aggregate output of 23,000 h. p.

The completion of Kaweah No. 5 plant, the reconstruction of Kaweah No. 1, and the enlargement of Kaweah No. 3, made possible by the Wolverton reservoir, will add 10,000 h.p., bringing the maximum aggregate output to 33,000 h. p.

Substations.

Substations of this company are placed either in towns or cities, or at the center of local distribution, where it has been determined that an economic point of voltage transformation should be obtained. The company maintains twelve substations, of which four are of the semi-outdoor type.

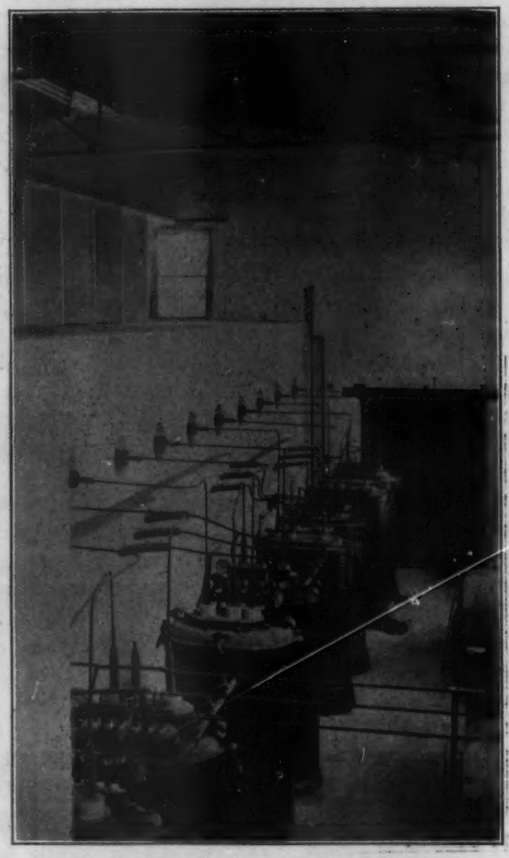
In Porterville, Visalia, Lindsay and Exeter, substations are in the central part of the towns. The newest and most complete of the substations is at Lindsay. Many of the substations in outlying districts are small corrugated iron buildings, and contain only the equipment necessary for a power service, and in many cases, do not require an attendant. The following list gives the type of building, transformer

capacity, voltage and number of circuits. A description of all the substations will not be entered into, but three of the principal types will be described.

Substations and Equipment.

Station.	Kind of Building.	Transformers. No.	K.v.a. Rating.	Capacity.	Secondary Voltage.	No. Secondary Circuits
Visalia	Brick	3	500	1500	2200	3
	Brick	3	350	1050	2200	1
Lindsay	Brick	4	500	2000	6600	5
	Brick	4	300	1200	2200	6
Porterville ..	Brick	2	500	1000	6600	4
	Brick	2	150	300	6600	1
	Brick	4	150	600	2200	3
Lemon Cove..	Cor. Iron	2	150	300	6600	2
Badger	Cor. Iron	2	75	150	2200	4
Venice Hill..	Cor. Iron	2	300	600	6600	1
Tulare	Cor. Iron	2	300	600	6600	3
	Cor. Iron	2	150	300	2200	4
Tipton	Cor. Iron	2	*300	600	6600	2
	Cor. Iron	2	300	600	6600	2
Delano	Cor. Iron	2	*500	1000	6600	5
Ducor	Cor. Iron	2	300	600	6600	4
Exeter	Cor. Iron	2	*300	600	2200	6
Success	Cor. Iron	2	*150	300	6600	2
Total: 12		44	....	13,300	....	58

*Outdoor Type Transformers.



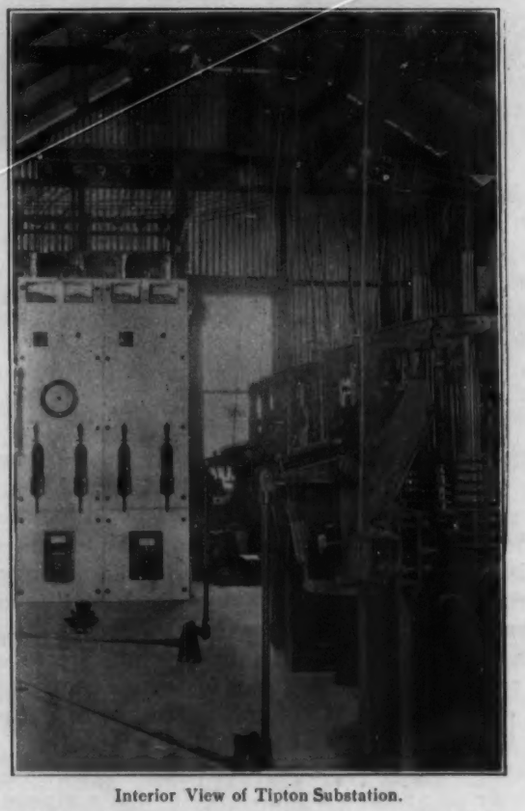
Lowering Transformers in Lindsay Substation.

The Lindsay Substation is of brick, in two stories. The office of the company is in the front part, off the street, as one enters. The swtichboard for this station is mounted in the office space, so that it faces the street, and gives a businesslike appearance therefrom. The switchboard is black slate in 14 panels. The first panel contains a T. A. voltage regulator, rheostat control, and one generator switch controlling a synchronous converter. The second panel is devoted to high tension oil switch control and relays. The third is similar to the second. The fourth and fifth panels are blank for future transmission installations. The sixth and seventh have the switch control mechanism and meters for the 2200 volt city distribution. The remaining panels control outgoing 6600 volt circuits for a large district surrounding Lindsay.

On the main floor back of the switchboard is a large space, in which is a synchronous condenser similar to the one in use at Visalia. This has a 35 h.p. induction starting motor, and is connected to the condenser through a magnetic clutch. This is a very satisfactory device for starting the machine.

The exciter for the synchronous condenser is a two bearing Westinghouse 27½ h.p. induction motor, operating at 1125 r.p.m., and driving a d.c. 17½ kw. generator. An Edison storage battery operates the high tension switches, being charged by a small motor generator kodak set. This consists of a 5 kw., d.c. machine, driven at 1800 r.p.m., by a 2-phase General Electric induction motor.

The high tension transmission lines enter either side of the building. For the present, but one side is used, two lines entering here. Over the office space, and placed within two racks of concrete barriers, are the high tension 34,000 volt circuit breakers for the incoming lines. At present but two of these switch sets are in service. The two incoming lines connect to these switches through disconnectors, and between the oil switches and the bus line which feeds the transformers, are another set of disconnectors. The station bus line passes from the cross bus between the high tension switches to the rear of the building.



Interior View of Tipton Substation.

On either side of these are the high tension transformer switch cells. For the present the cells on one side only are equipped with switches, as but one-half of the transformer equipment has been installed. There are four sets of General Electric K-21 oil circuit breakers, which control the 34,000 volt lines, each

to a pair of General Electric lowering transformers. These transformers are wound for 30,000 volts on the high tension side, and are Scott-connected for 2300, or for 6600 volts, as the case may be, on the low tension side. Two sets of these transformers have a capacity of 300 kw., and the remaining two sets of 500 kw. each.

In the space devoted to the transformers are two 2-phase General Electric aluminum cell lightning arresters on the 6600 volt outgoing circuits, and also one General Electric constant current arc transformer, having a capacity of 14.6 kw., and with a current value of 6.6 amperes to supply a city street lighting service.

At Exeter and Delano, two new substations now approaching completion, are of a new type which has been adopted as standard. These stations have a two-story reinforced concrete building. On the first floor in front is the company's local office, and the switchboard controlling high tension and distributing lines. The high tension switching apparatus and bus lines are on the second floor. The high tension lines enter at one side, passing through oil circuit-breakers and disconnectors, to the main bus lines which run the length of the building, thence through a second set of circuit-breakers, passing through the opposite wall of the building to the out-door transformers. The transformers of which there are four at Delano and four at Exeter, are oil and air cooled, having capacities of 500 k.v.a, and are wound for 2200 volts secondary and are delta-connected. The secondary lines are carried back into the building to the low tension switches. A novel feature in the design of these stations is the use of the reinforced concrete roof trusses as barriers between the high tension bus conductors.

The Tipton Substation represents the semi-outdoor type. The station consists of a small corrugated iron building 30x15 ft., with a concrete floor. In this building is a 2 panel switchboard. Each panel has the remote control for two 6600 volt circuit breakers, together with the necessary instruments. Two K-21, 34,000 volt oil circuit breakers are equipped with mechanical remote control from a third marble panel. From this station there are four outgoing 6600 volt 2-phase circuits. The transformer equipment consists of a pair of air and oil-cooled corrugated case transformers, wound for 30,000 volt primary, to 6600 volts secondary, and Scott-connected for 2-phase operation. These have a capacity of 300 kw. The terminals are of the weather-proof type, and the transformers are placed on concrete bases in the station yard, about 50 ft. from the building.

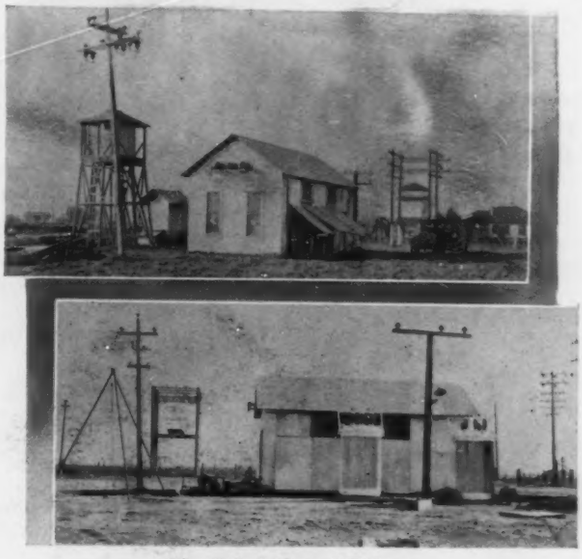
Two other similar transformers within the building are still in use. Since the original installation, the outdoor transformers having been added as the load upon the station increased. This substation is the junction of three transmission lines, being a sectionalizing point in the north and south lines and a junction point with the cross line to Porterville. All of the apparatus is of General Electric manufacture.

The remaining substations in the system are very similar to the last two which have been described, both in size of equipment, and in arrangement.

The demand for power during the coming year has been provided for by the ordering of additional transformers aggregating 10,000 k.v.a. in twenty units, which will be added to the various substations during the coming year. These are all of the outdoor type described for the Exeter and Delano substations.

Transmission and Distribution System.

The transmission system between the power houses and the substations as well as the various tie lines, is operated at approximately 34,000 volts, and is a 3-phase system throughout. The territory covered is extensive in point of area, but is condensed



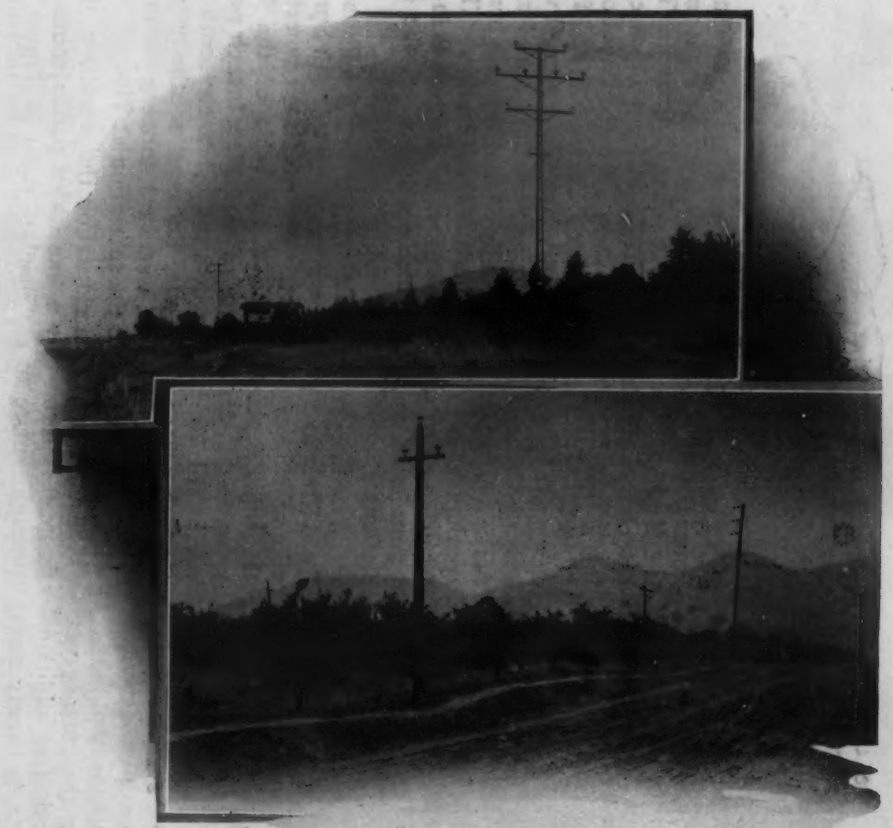
(1) Substation at Tulare.
(2) Substation at Tipton, Showing Outdoor Transformers and Distributing Tower Structure.

in point of service distribution. There are no extreme lengths of transmission, and, therefore, there is no object in employing extreme voltages on these lines. The average distance from the power stations to the center of distribution is about 35 miles.

The transmission system consists of two main lines, the one from the group of power stations on the Kaweah River, while the other is from the Tule plant on the Tule River. The first line, which commences at Power House No. 3, is carried to Power House No. 1, thence to Power House No. 2, and from this point follows the Kaweah River in a general way, passing through Lemon Cove to a point about 4 miles north of Exeter. Here the line branches, one branch continuing to Visalia, the other to Exeter. These branches form the upper corner of a figure 8 in the transmission network which reaches all of the substations.

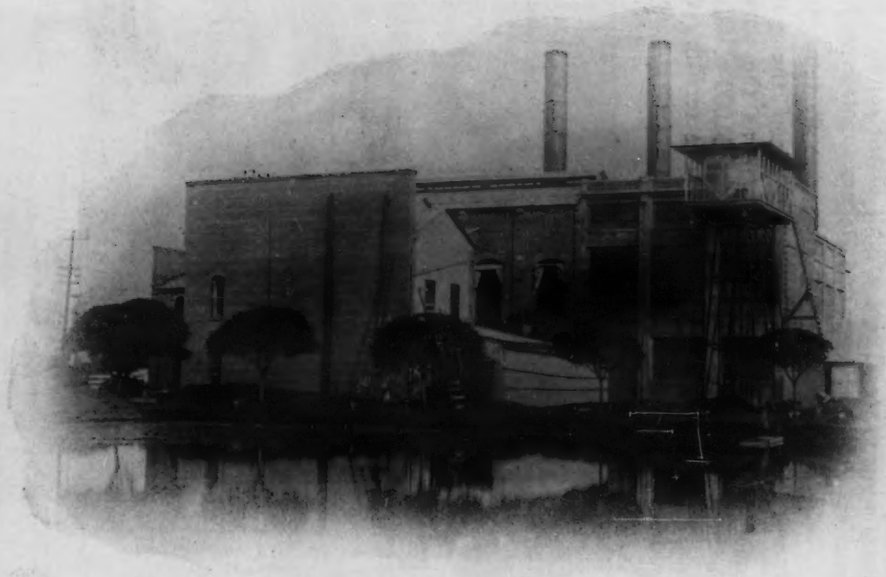
The line from the Tule power house follows the Tule River in a general way, passing through Springville and Success to Porterville, where it connects at the middle point of the eastern side of the forementioned figure 8. From Porterville a branch passes northward to Exeter, a second branch southward through Ducor to Delano, the most southerly point of the line, and a third, westward, forming the center line of the figure 8, to the substation at Tipton.

From the Visalia substation the west side of the figure 8 is formed by a line which passes southward through Tulare to the junction point at Tipton, and



(1) Two Circuit 35,000-Volt Line Near Porterville, on Tripartite Steel Poles.
(2) High Tension Wood Pole Line, Showing a Novel Corner Pole Construction.

(1) A Portion of the Merryman Ranch Orange Groves; the Main Pump House and Reservoir.
(2) The Home of an Orange Grower, Surrounded by His Orchard, Near Lemon Cove.



The Visalia Steam Plant and Cooling Pond.

Lindsay Substation, Showing Tower Rack for Outgoing 6600-Volt Circuits.

from this point continues southward to join the line from Porterville at Delano.

The main transmission lines and the above described high tension distribution have a total length of 182 miles. Much of the transmission follows county roads, the use of which is possible by franchises from

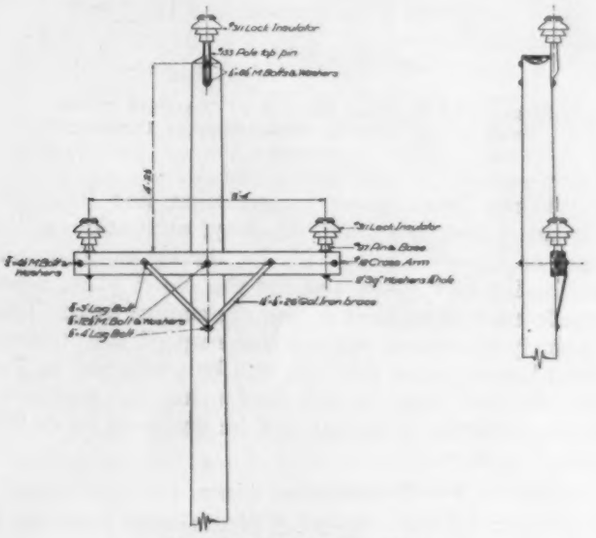
A Junction on the 35,000-Volt Transmission; Tripartite Steel Poles.

Tulare and Kern counties. There are also many miles of line over private right-of-way, which has been purchased by the company.

The construction follows standard practice, and in nearly all cases the transmission lines have a single circuit, in which there is one crossarm carrying two of the conductors, while the third is mounted on a pin at top of the pole. There are a few places where double construction is used, in which case there are two arms, the circuits forming triangles on either side of the pole.

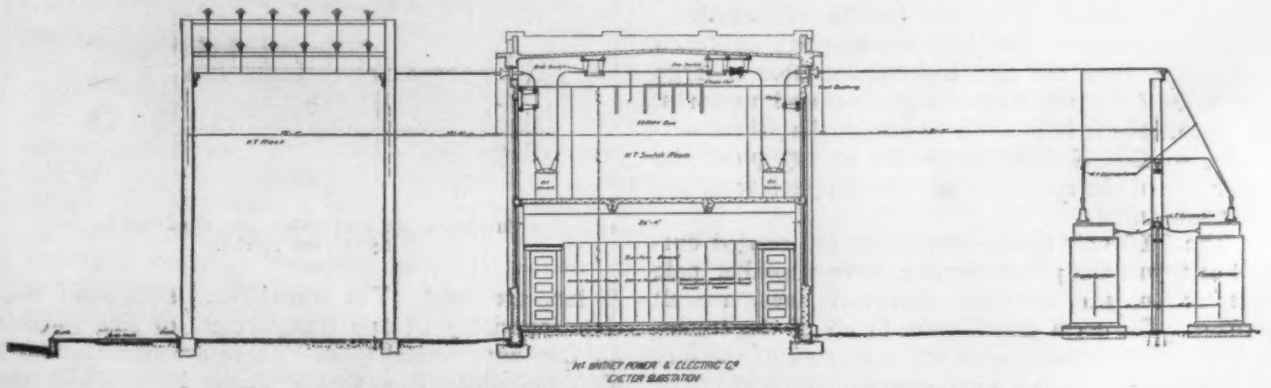
The main line from the Kaweah plants consists largely of 30 and 35 ft. sawn butt-redwood poles. This line was built at the time that the No. 1 Plant was built, fifteen years ago, and it is said to be in a remarkably good state of preservation. The line from the Tule power house to Porterville is constructed of round Washington cedar poles, 35 and 40 ft. long. The remainder of the transmission is largely of the same type of construction.

There is a unique feature in making sharp turns in the single circuit lines, these turns being necessary where the line follows county roads, and where the roads follow section lines. This consists of a pole on which there are three suspension type deadend insulators, placed one above the other, and fastened directly to the pole without the use of a crossarm. The pole is guyed back to equalize the strain of the transmission wires.



Standard Wood Pole Top.

At one point in the transmission between Porterville and Lindsay there has been adopted the Tripartite type of steel pole. These poles carry both single and double circuits. The Tripartite pole is made of three steel "U's" which are held together by structural sections, fastened by rivets. The crossarms are angle sections, carrying insulators with steel pins. These poles are 40 ft. long, and weigh 1100 lb. each. They make an exceedingly durable construction for



Cross Section of New Standard Reinforced Concrete Substations at Exeter and Delano.

a transmission line where the weight of conductors is not excessive, and also make a pleasing appearance.

The transmission lines are sectionalized at the various substations through pole-top switches, and also at some points through oil circuit breakers. The system of transmission is such that in case of trouble at any point, the section where the trouble occurs can be cut out, and power can be fed around in another direction. This is possible by the figure 8 high tension network which is fed into at three points.

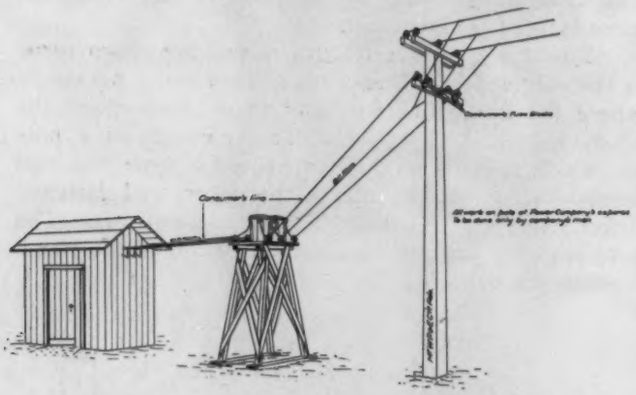


Diagram of Standard Method of Mounting Transformers, and Making Connections to Pumping Plants.

A new steel tower transmission line from the Kaweah power plants to Lindsay, substation a distance of 33 miles, to provide for the increased output of No. 3 power house and for the No. 5 plant when completed, will be built during the coming year. This is clearly shown on the general map of this system. From Lindsay this new line will be continued to Tulare and will form a new feeder for the west side of the network. This line will be designed for 66,000 volts operation.

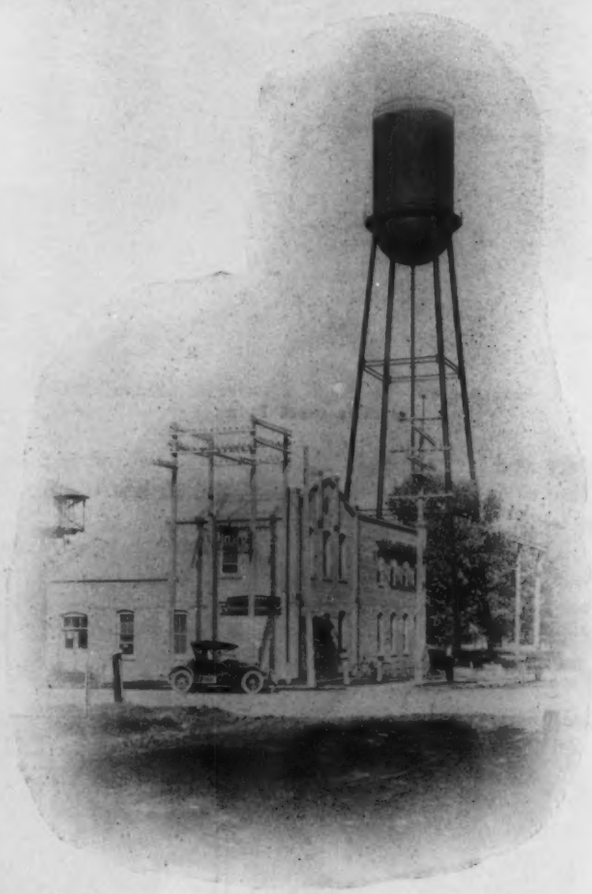
Distribution Lines.

There are two types of distribution lines used. The one which covers the greater part of the distribution system operates at 6600 volts. The other, which is for service within towns and cities, is for 2200 volts.

The 6600 volt distribution lines are very extensive, and cover practically every part of the territory which is served by this system. The poles are round Washington cedar 30 and 35 ft. long, and carry a single crossarm with three insulators. The entire 6600 volt service is 2-phase, and is distributed on three conductors, the center conductor being a common wire between the phases. Wherever distribution lines from different substations, in their meanderings approach each other, they are tied together, so that a large part of the distribution system forms closed networks. By this means it is possible to sectionalize these networks, so that if there is trouble at any point the remainder of the networks may be supplied from another substation.

The 2200 volt lines, where they are carried outside of towns for power service, have a similar pole construction, and like the 6600 volt lines, are all 2-phase. The local distribution in all of the towns, is 2200 volts, 2-phase, with the exception of the city of Visalia. Here the local distribution is 3-phase. Sectionalizing pole switches are used throughout the 6600 volt networks for the control of these lines. These switches are hand operated, and are of the double break swivel type, manufactured by the K. P. F. Electric Company of San Francisco. There is an aggregate of 1080 miles of 6600 and 2200 volt, 2-phase distribution lines.

A noticeable departure from current practice has been maintained in the mounting of power distribution transformers. It has been noted that the principal power business is pumping water for irrigation of orchards and farms. There are something over thirteen hundred pumping units which are served by the distributing lines of this system. Each one of these units consists of a small building, in which are placed either a centrifugal, or a deep well plunger pump, driven by an induction motor. These plants vary widely in their appearance and design, some of them being elaborate and artistically finished, others being nothing more than a protection for the enclosed machinery. Those plants which are near the foothills where water is at some distance from the surface. have deep well pumps. The plants located further out in the valley and toward the western part of the area covered by the system, where water is nearer the surface, are equipped with centrifugal pumps, but in all cases 2-phase induction motors of from one to



The Substation at Porterville. In the Rear Is the City Water Works.

75 h.p. are used. The transformer equipment consists invariably of two transformers of size suitable for the motor installation. These are mounted on a platform which is generally about 10 ft. above the

ground, and is supported on a timber structure properly braced. The object in using this type of transformer mounting instead of hanging the transformers over a crossarm on the pole, has been two-fold. It removes the danger of contact with high tension wires, which are brought from the pole directly to the tops of the transformers, and in the event of trouble to the transformer, the entire installation is away

Water Works and 100,000 Gallon Tank at Exeter.

from charged wires upon removing fuses. The fuse blocks, which protect the transformers, are mounted on a crossarm in the usual manner on the nearest pole. The second reason for this mounting is to facilitate the care and examination of the transformers and make it possible for others beside the company's employes to erect the transformer structure and place the transformers in position, the cost of this method being no greater than if the transformers were mounted on the pole.

Aside from pumping water for irrigation, the company supplies power for all the towns and cities which are reached by its lines. In the city of Tulare the water supply is owned and operated by the municipality, which also owns the power equipment for pumping. This consists of one Krogh 2-stage 6 in., and one 1-stage, 8-in. centrifugal pump, driven by a 50 h.p. induction motor. This plant pumps water into a 150,000 gal. tank, whose elevation above the ground is 132 ft. At Exeter a similar municipal system is operated by the company, there being here two 20 h.p. induction motors, which drive two, 2-stage 5 in., centrifugal pumps. Here also is an elevated tank, having a capacity of 100,000 gal.

At Porterville a 50 h.p. induction motor drives a 2-stage centrifugal pump, which supplies a 75,000 gal. tank, while in another part of the city a 30 h.p. motor drives a vertical centrifugal pump, supplying water to a 300,000 gal. tank, which is placed on a hill back of the city.

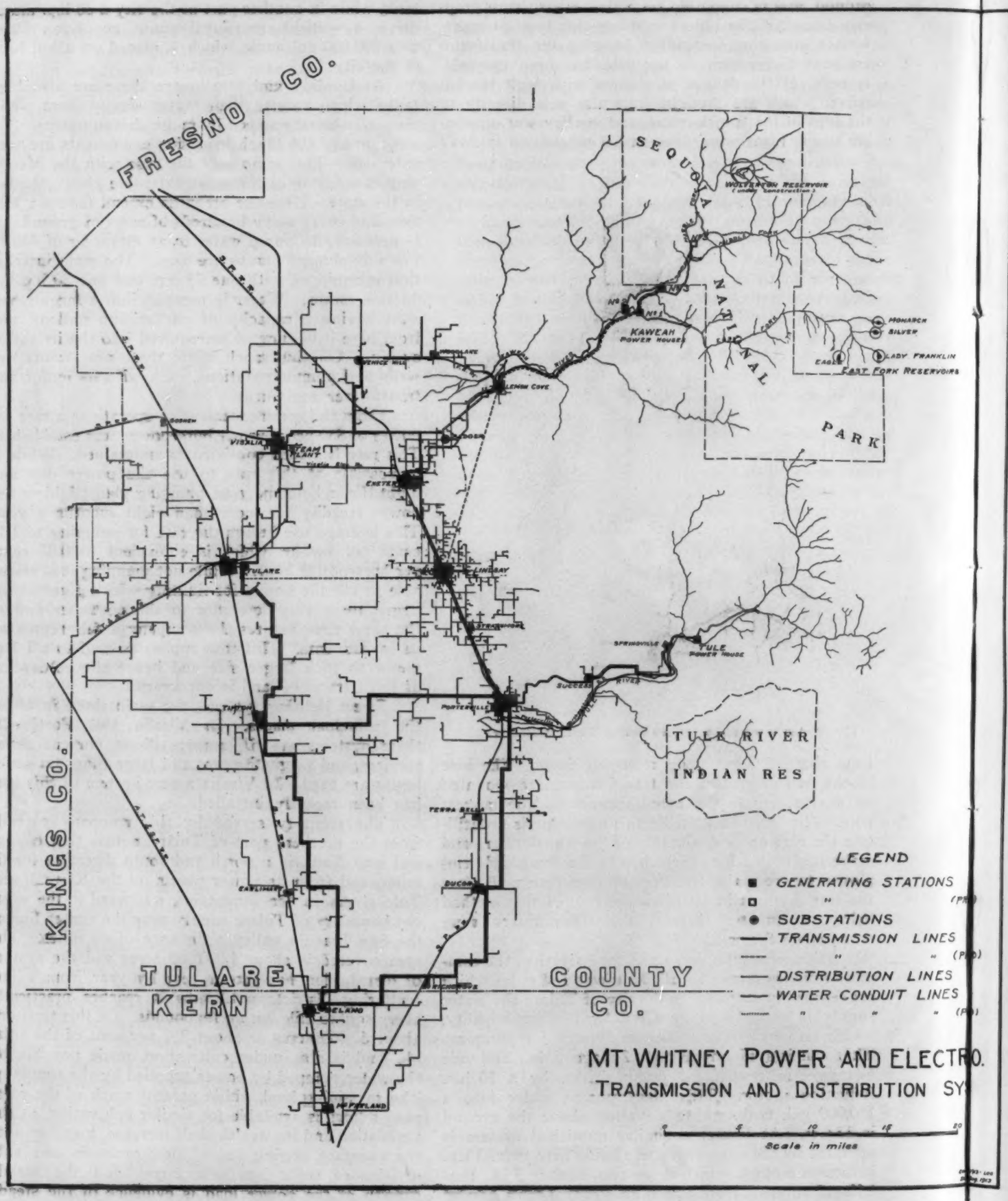
At Lindsay and Strathmore there are also high tanks which receive their water supply from wells, the water being pumped by motor driven pumps.

Some of the ranch irrigation equipments are very extensive. This is notably the case with the Merryman ranch, one of the most extensive citrus ranches in the state. Here the orchards extend far up a hillside, and cover many hundreds of acres of ground. It is necessary to pump water to an elevation of 440 ft. For this plunger pumps are used. The main installation is equipped with one 75 h.p. and one 30 h.p. induction motor. Water is pumped into a large reservoir, having a capacity of one million gallons, and from here it is pumped as required into the irrigation system. On this ranch alone there are twenty-two wells and pumping stations, each with its motor and transformer equipment.

From the commencement of operations a rate for power of $50 per year per horsepower was established. This rate has been consistently maintained. While it is possible at this rate to use the power day and night throughout the year, pumping plants seldom use power steadily for more than eight months a year. This average use brings the rate for pumping to 1.16 cents per kw.-hr. which is equivalent to 0.87 cents per horsepower hour. While not pumping it is allowable to use the power for lighting which gives in the aggregate a very low rate to the customer and at the same time assures the company a fair return on its investments. This rate applies as well to a 1 h.p. motor as to a larger size and hence the cultivation of small tracts of land is encouraged.

Street lighting systems are maintained in all of the principal places. In Visalia and Porterville these systems are 6.6 ampere direct current series services, and magnetite arcs and large tungsten series lamps are used. In Visalia a new system of this sort has been recently installed.

The territory served by this company extends from the northern part of Tulare, across that county and into Kern, in a north and south direction for 60 miles, and from its power plants on the Kaweah and Tule rivers in the mountains, westward to the western boundary of Tulare county near the center line of the San Joaquin valley a distance of 40 miles. The area covered is about 1,000,000 acres and the system of distribution has grown year by year from a few scattering districts until now it reaches practically every square mile within its bounds. Of this territory about 60,000 acres or about 8½ per cent of the tillable land is now under cultivation, made possible by the water pumped by power supplied by the company. The remaining land within present reach of the company's lines is available for similar cultivation, as the population and its wealth shall increase, together with the constant setting out of new orchards, the subdivision of lands into new farms and the steady growth of the power load is evidence of the steady and healthful growth. It is also evident that the opportunity for growth within the territory covered is enormous.


FRESNO CO.
SEQUOIA NATIONAL PARK
WOLVERTON RESERVOIR
KAWEAH POWER HOUSE
MONARCH
SILVER
LADY FRANKLIN
EAST FORK RESERVOIRS
VENICE HILL
LEMON COVE
VISALIA
STEAM PLANT
EXETER
TULARE
LINDSAY
SPRINGVILLE
TULE POWER HOUSE
TULE RIVER INDIAN RES
PORTERVILLE
TERRA BELLA
DUCOR
EARLIMART
DELANO
McFARLAND
KINGS CO.
TULARE CO.
KERN CO.
LEGEND
GENERATING STATIONS
" (P.S.)
SUBSTATIONS
TRANSMISSION LINES
" " (P.S.)
DISTRIBUTION LINES
WATER CONDUIT LINES
" " " (P.S.)
MT WHITNEY POWER AND ELECTRIC CO.
TRANSMISSION AND DISTRIBUTION SYSTEM
0 5 10 15 20
Scale in miles

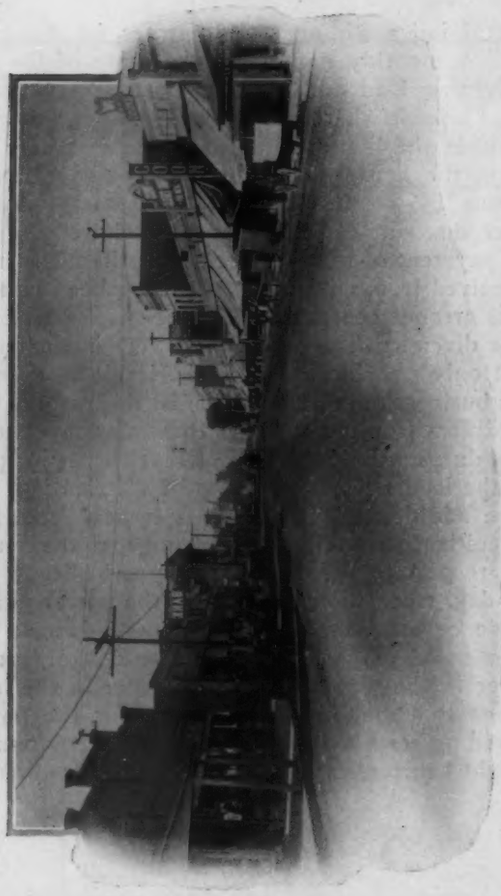
While the pumping load absorbs 70 per cent of the annual kilowatt-hour output from the plants, there is a steadily growing industrial power load, in every use which may be found in cities and outlying communities. Notable among the diversified power supplies, is that for operation of the Visalia Electric Railway system. This is an interurban line which extends from Visalia, the county seat, and the largest city in Tulare county eastward through Exeter and then winding through the orange orchards among the foothills, having its terminus at Lemon Cove, a total distance of 35 miles. Numerous branches make possible an outlet for the extensive shipments of the citrus fruits, whose cultivation on a large scale is made possible from the supply of power by this company. This railroad, which is a feeder to the Southern Pacific, receives power at its transforming substation in Exeter and distributes this power along its lines, through its own substations, for the operation of its trains.

The third branch of the power business of this company, which is at the present time undergoing a phenomenal growth, is the supply of electricity for lighting and heating. The former is common to all electrical systems in populous communities, but the supply of power for heating and cooking has, as a rule, scarcely passed the novelty stage. An especial effort has been put forth to develop this feature of the business by giving a sliding scale of rates for domestic service. A monthly minimum takes care of the average lighting load and the rate then automatically lowers to a point where heating and cooking cost will come within the limits usually allowed for these expenses in the household. These rates range downward from 10½ cents to 1 cent per kilowatt-hour and a further discount of 15 per cent is allowed for the prompt payment of bills. Scores of testimonials have been received from customers who have been pleased with this arrangement,

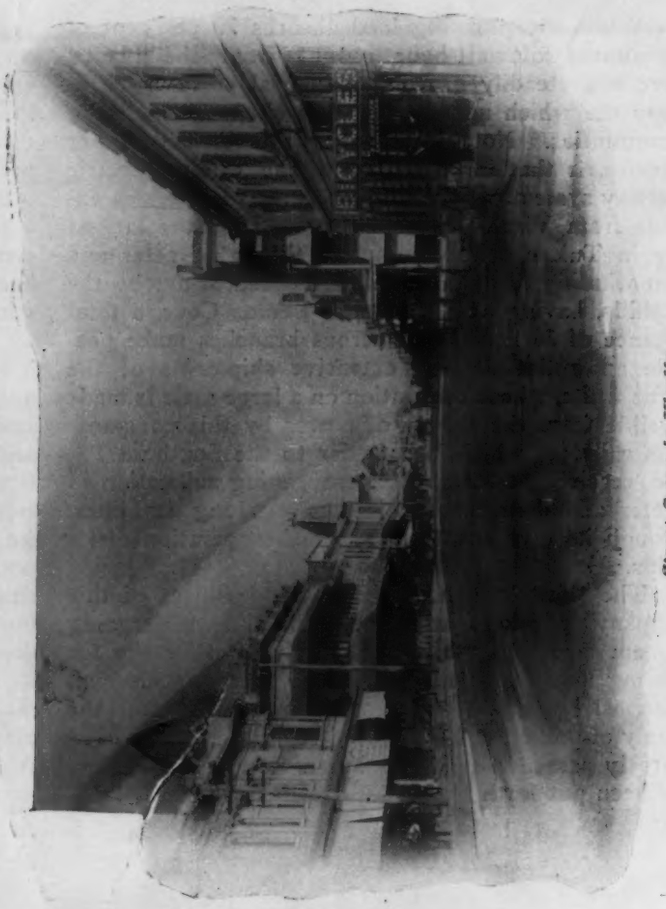
The diversity factor of this system is such that it is not only possible but quite advisable to encourage this business on a large scale. In this respect this system differs from many other transmission systems and it is due, not only to the fact that the major portion of the load is a pumping load for irrigation, but from the additional fact that it is largely irrigation for the cultivation of citrus fruits and that the period both in respect to the time of year and also to the time of day, when there is a sag in the power pumping curve covers the time of maximum demand for domestic uses. This situation of load is a further assistance in the matter of storing water in the high mountains to uphold low water flow for the power plants and makes a much smaller storage requirement than might be necessary if the load were of a different nature.

Typical Irrigation Pumping Plants.

(1) Pump House of El Cerritos Rancho, Near Lindsay.
(2) Pump House and Tank on St. Johns River Colony.
(3) Typical Deep Well Pump Near Lindsay.
(4) A New Pump Installation in the Center of a Young Orchard.

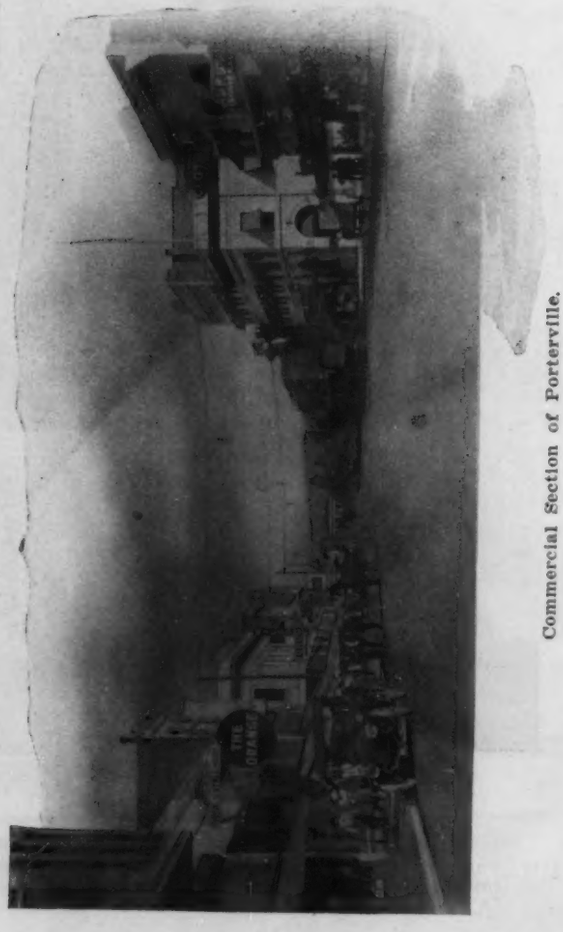


Street Scene in Lindsay.



Street Scene in Visalia.

An Orange Orchard Near Lindsay.



Commercial Section of Porterville.

The advent of electricity for pumping has virtually displaced the steam or gasoline engine for this purpose and the systems in use for putting water on the land are diversified and in many cases extensive.

While the greatest horticultural development has been along the lines of citrus fruit culture, the irrigated areas are by no means devoted entirely to this

An Olive Orchard Near Lindsay.

industry. Large tracts of vineyard are under cultivation and alfalfa, maize and sugar beets are among the other products. Near Visalia there is a beet sugar factory supported by the beet production of the locality, this is operated by electricity furnished by the company.

A new horticultural industry has been established, being made possible through the power supply of this company. This is the raising of Turkish tobacco. That this promises to be a very important addition to the rapidly growing resources of this territory is evinced by the fact of the rapid growth in the production. During the last year over 200,000 lb. of tobacco was raised and sold, an average price of 50c per lb. being obtained by the grower.

The raising of the finest naval oranges, lemons and grape-fruit represents perhaps the highest use of the land.

In Tulare county and within the reach of the lines of the company there is now planted an aggregate of 40,000 acres in naval oranges alone, over 6000 acres having been planted during the last year. This does not include the acreage devoted to the other citrus fruits, but forms about one-fifth of the entire acreage planted to citrus fruits within the state of California. The shipments of these fruits for the past year from this district amounted to 5000 carloads. What is known as the citrus belt is somewhat limited to the lower foothills and the valley land which adjoins the foothills or extends between isolated knolls. And while one may travel along the county roads hour after hour between solid rows of orange trees, he may see, extending far up the hillsides and as far as the eye can reach, the regular lines of the rich sombre colored foliage characteristic of all citrus trees. There are many little valleys nestling far into the higher foothills and even approaching the mountain canyons and these are dotted with orchards and will eventually be thoroughly filled with the intensively cultivated trees. Almost everywhere one may look, he may count on seeing a small pumping plant building, often very tastefully finished and decorated to blend with the color and regularity of the surrounding trees, containing the pump and motor, and outside the supply transformers and the poles and lines of the company.

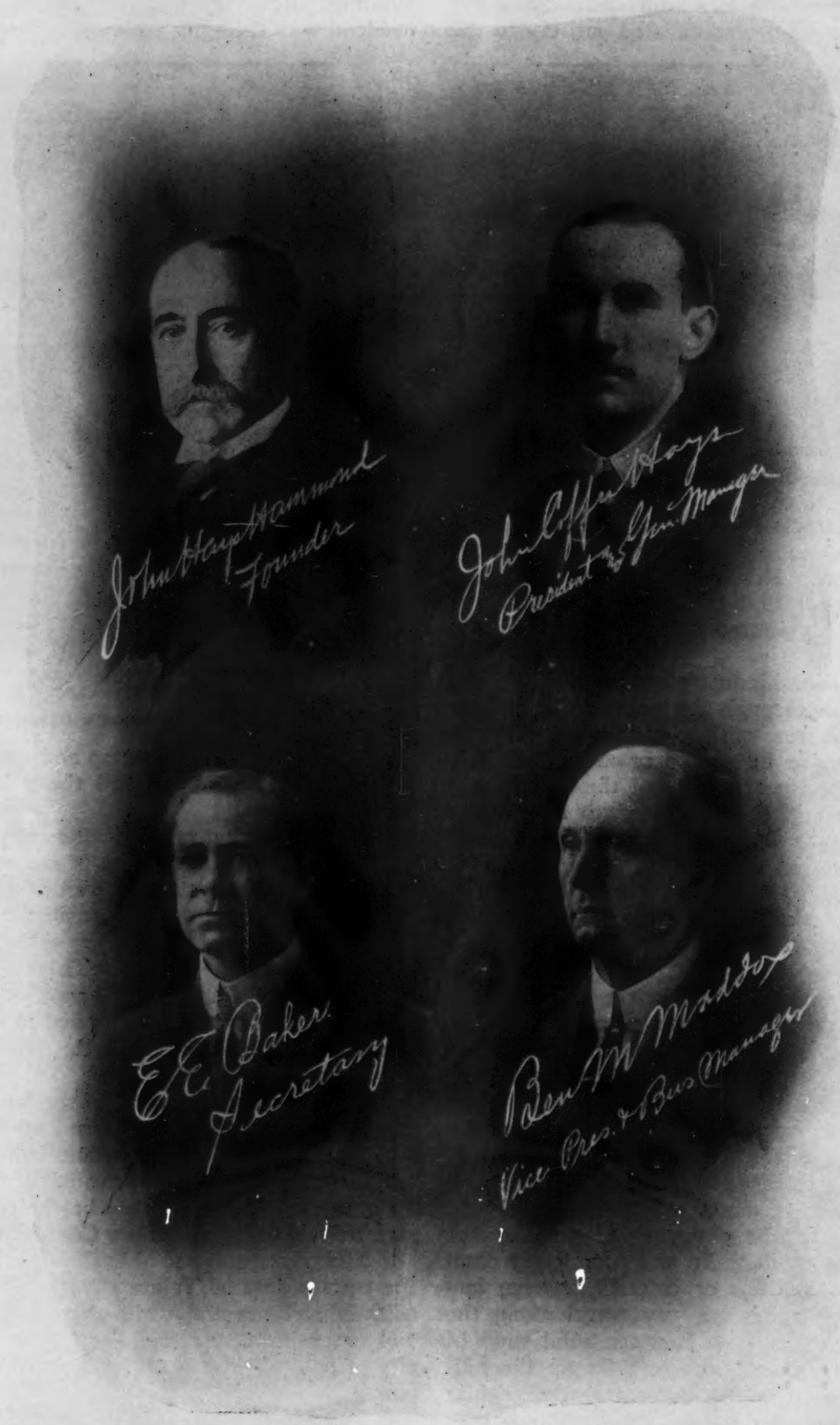
Views of the Company's Office, Visalia.

The population served will aggregate 60,000, and while much of this number is scattered among the ranches, there are prosperous cities and towns which give every evidence of the wonderful productiveness and wealth which has been an essential part of the development of the county. These cities as well as the outlying section are well supplied with the company's service for all purposes and in each place there is maintained an office and the force necessary for the surrounding district.

Twenty years ago most of the land served by the company's lines might have been purchased from $10 to $15 per acre. Today raw land is held at from $250 to $400 per acre, due to the availability of cheap power for pumping. This company has helped to add to the assessed valuation of Tulare County over $25,000,000.

The principal place of business is Visalia which is the county seat of Tulare county. This is a city of 6000 inhabitants and while there is a well arranged and extensive commercial section, it is essentially a city of homes. Here are the main offices of the company.

These are housed in a commodious two-story brick building. As one enters, a large space is pre-


John Hays Hammond
Founder
John C. Hays
President & Gen. Manager
E. E. Baker
Secretary
Ben M. Maddox
Vice Pres. & Bus. Manager

sented devoted to the local business of the company, where there is also on exhibition various electrical appliances for heating and cooking. In the rear are the offices of the various business departments. On the second floor are the offices of the president and the business manager which are well appointed and in keeping with the importance and magnitude of the business over which they have control. The remainder of this floor is given over to the offices of engineers and a large drafting room. Even with these commodious quarters, the business of the company is increasing so rapidly that the space available has become already overcrowded and it is proposed to add a third floor in the near future. From this point the power load for the system is handled, a load despatcher being at all times in touch with every part of the system by means of the company's own telephone system.

The second city in importance is Porterville. This city of 4000 people, is 32 miles southeast of Visalia and is beautifully situated at the base of the foothills in the midst of the citrus belt. This city makes an exceedingly favorable impression upon the visitor by its fine streets and many handsome buildings. The local distributing system originally owned by the Porterville Light & Power Company, was purchased by the company in 1900.

The city of Tulare is 10 miles south of Visalia on the main line of the Southern Pacific and a branch line of the Atchison, Topeka & Santa Fe Railway. It has a population of 3000 and is similar in many of its characteristics to the county seat. It is surrounded by a rich farming country. The company's office here is in the center of the commercial district while the substation is about a mile east of the city.

Exeter and Lindsay are well laid out and rapidly growing towns of about 2000 inhabitants each, both possessing many beautiful homes and fine public buildings. They are located southeast of Visalia and between that city and Porterville and are in the midst of orange groves. They are important fruit shipping points and contain extensive packing houses and cooling stations. Lemon Cove and Springville are well back into the foothills and are also important fruit shipping points. The remaining places where local service is maintained are the centers of rapidly growing agricultural districts and have substations from which service to the district which surrounds them is delivered.

It is due to the courtesy and assistance of Mr. John Coffee Hays, president, Mr. Ben M. Maddox, business manager, and Mr. H. A. Kluegel, chief engineer of the Mt Whitney Power & Electric Company, that it has been possible for the writer to obtain the detailed information for this description and the facilities for taking the great number of photographs by which it has been illustrated.

Mineral Production in Utah places that state second in silver, third in lead, fourth in copper, sixth in gold and seventh in lead. Utah holds a unique position among the metal-producing states in the diversity of its mineral output. The total output of this state for 1912 was $51,004,942, which is an increase over 1911 of $7,230,611.

"PARTNERSHIPS" VS. "PRINCIPAL AND AGENT" IN PUBLIC UTILITY RATE MAKING.

BY J. F. DIX.

(This article is submitted by the author as a comment upon the theory of Principal and Agent as the fundamental relationship existing between the public and its public utilities, and in presenting his views upon this subject the author advocates as a more equitable basis of rate making a consideration of that relationship instead as a Partnership, and gives much interesting matter in support of this different view.—The Editors.)

Commissioner Max Thelen of the Railroad Commission of the state of California, in the issue of the Journal of Electricity, Power and Gas of November 22, 1913; under the title of "A New Rate Making Basis" has developed the idea that "the fundamental relationship existing between the public and its public utilities is that of principal and agent." The commissioner has undoubtedly attempted to place the question of rate making upon a sound basis by a return to first principles, and the exposition of his theory is worthy of serious consideration. In view of the recent trend in matters of this kind, wherein hypothetical reasoning and mathematical gymnastics seem to have taken the place of logical thought, a return to fundamentals is indeed healthy. At first glance the "principal and agent" argument is extremely plausible but further thought leads one to believe that there is certainly a better and far more equitable basis for rate making than this idea permits.

In agency, an agent is entitled to be reimbursed for the money which he expends for the benefit and account of the principal together with proper remuneration for his services. It is also true that any profits which may accrue from the actions of the agent on behalf of his principal should be solely for the benefit of the principal. This idea may be applied to public service corporations in a certain moral sense; but is it a sound basis for rate making? Is the agent comparable to the utility, when one considers that the agent in the usual acceptance of the word carries no investment, other than a relatively small working capital, while on the other hand, the public utility makes the entire money sacrifice? To illustrate the point recourse may be had to a very common realty transaction. A wishes to appoint B his agent, and states to B: "I own a tract of land which I wish to develop and sell; reposing trust in your ability and honesty I will appoint you my agent, setting aside a sum of money at your disposal to be used in the development of the property. For this effort on your part, I will compensate you with a certain sum each year." In this example B, the agent, will make no investment, will assume no risk and assuredly will not expect to derive any profit from the sale of the land but will look to the salary paid him to act as agent for his remuneration.

Is it just or equitable to treat a public utility organized and built up by private initiative courage and capital, merely as an agent? This would be parallel to A saying to B: "I own a tract of swamp land of little value. If you, at your own expense will drain the land construct streets and otherwise develop the property and if the land is sold at a large profit, I will return to you your investment, plus a certain compensation for your services." B under such conditions, would hardly be eager to act as agent for A, and yet

such a case is exactly analogous to the conditions proposed to impose upon public service corporations. Few indeed would be the utilities initiated by private capital, if it were known in advance that the "principal and agent" measure were to be applied after the pioneering and development stage, and as a reward for courage. If the public is to consider itself the principal, and at this late day is to look upon public utility corporations in the light of agents and is to ask its so-called agents not only to provide adequate service, but in addition is to ask that its agents invest their own money, then the day of private ownership is at an end and government ownership is in the near future.

An analysis of the conditions just preceding the organization of a public utility should give the basis for the relationship between the public and its public utilities. The conditions precedent to any contract are the basis of agreement during the life of the contract, whether the relationship be that of master and servant, principal and agent, or any other. In the early days of electric light service, when little was known of the art as it is developed today and only the most far-sighted could see its future prospects; few, if any municipalities did build or were willing to build plants, choosing rather to expend their efforts and money to make extensions in the better known fields of road building and water works. Here and there groups of men went before the public or their representatives willing to invest their money in a hazardous undertaking, to supply an improved form of lighting, merely asking, that in return they be allowed to use the public streets in order that service might be supplied. In this tremendous industry as it exists today, the public, in the meaning of the word as used in this article, has not invested a cent, has risked nothing, has made comparatively no effort and yet it is proposed that it shall now usurp the place of principal and assign to corporations, who have done these very things, the inferior position of agent, as a reward for success. Would it not be more just and more equitable to term the relationship between the public and its public utilities as "partnership" rather than "principal and agent."

Partnership is the result of a contract whereby two or more persons agree to combine for the purpose of a common undertaking and the acquisition of a common profit. This relationship may be illustrated by reference to the second example above outlined, except in this instance. A would say to B: "I own a tract of swamp land of little value, but of such location that, if properly developed, should yield large profits. If you, at your own expense will drain the land, construct streets and otherwise develop the property, we will form a partnership and the profits secured from the sale of the land, will be shared between us. I have little faith in the project, and I have other uses for my money, but if you believe it can be done and will invest your money, we will share the profits."

This is analogous to the case of the public utility for the public had little knowledge of the service to be rendered or its possibilities and offered as its contribution to the partnership, the use of its streets. In order that the work might not be unduly hindered, the public in addition granted to those who were to contribute their money and time, the power of eminent domain. The profit to be derived from such a combination will be service to the public and a return on the money invested to the promoters of the utility. And if, in this partnership the public may on the one hand receive increased profits from improved service as the industry is perfected, may not the public service corporation, on the other hand realize added profits on the increase of their money investment? If we accept the "principal and agent" theory; appreciation of values can not be allowed in rate making or we would violate the fundamentals of that relationship, but if we apply the rules of partnership, one partner can not enjoy the profits to the exclusion of the other. That the corporation is entitled to earn on what ever increase in value has taken place in its property would seem to be confirmed in Wilcox vs. Consolidated Gas Company, 212 U. S. 52 (1909) wherein the Supreme Court states: "and we concur with the court below in holding that the value of the property is to be determined as of the time when the inquiry is made regarding the rates. If the property, which legally enters into the consideration of the question of rates, has increased in value since it was acquired, the company is entitled to the benefit of such increase." If in rate making under the "principal and agent" idea it is impossible to allow a return upon the increased value of real estate or other property, then the highest court in the land does not endorse the plan, if we are to accept as final the above citation.

No attempt is made to claim that the "partnership" plan as noted herein of itself would be acceptable or that any other single basis can be acceptable; but if choice must be made between the two thoughts, and if, all things considered, justice and fair dealing to both sides are the ends sought in any rate investigation, success will not lie in the "principal and agent" basis. In fact, any attempt to deduce the value of a public utility upon which to base a rate, through a mathematical formula or other means to a single basis must be unsuccessful. In a subject of such magnitude, the greater the number of angles of approach, the more diverse the points of view, the more care with which the various factors are weighed, the greater the measure of success and the greater the possibility that the final result will do justice, both to the public and to its partners, who carry the investment and shoulder the annoyances and risks in supplying the necessities and conveniences commonly included under the head of public utilities. This has been clearly stated by Mr. Justice Harlan in Smyth vs. Ames 169 U. S. 546 (1898): "We hold, however, that the basis of all calculations as to the reasonableness of rates to be charged by a corporation * * * must be the fair value of the property being used by it for the convenience of the public, and in order to ascertain that value, the original cost of construction, the amount expended in permanent improvements, the amount and market value of its bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property under the particular rates prescribed by statute, and the sum required to meet operating expenes, are

all matters for consideration and are to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property. What the company is entitled to ask is a fair return upon the value of that which it employs for the public convenience. On the other hand, what the public is entitled to demand is that no more may be exacted from it for the use of a public highway than the services rendered by it are reasonably worth."

Therefore, if we are to determine the true value, we must consider:

1. The worth of the service to the public.
2. The capitalized value of the undertaking.
3. The market value of the stocks and bonds.
4. The reproduction cost or the cost new of the property.
5. The present value of the property, and
6. The original cost.

And having all these, they should in the words of Mr. Justice Harlan "be given consideration, and allowed that weight to which it is entitled. It is, after all, very much a question of sound and well instructed judgment." If we are to attempt to base a rate on but one of these, or are to consider values solely on such an assumed relationship as outlined under the "principal and agent" idea, then we remove the incentive for improvement by removing the reward for improvement; discourage investment in utility securities by reducing the return for such investment, and the public will be deprived of service or the improvement of service, that is its share in the common profits of the partnership with the public service corporations.

The Nitrogen-filled Electric Lamp will be one of the most interesting of the numerous engineering novelties that will be included in the equipment of the Panama-Pacific International Exposition in 1915. This lamp was developed by Dr. Irving Langmuir, of the research laboratory of the General Electric Company at Schenectady, N. Y. It will be used for the first time in general, useful practice, in the standard lighting in all the small courts of the exposition, and throughout the Court of the Sun and Stars, including the fountains in that great central court. The lamps will vary in candle-power between 1,525 and 2,500, and there may be a few as high as 5,000 candle-power. For years, efforts have been made to produce lamps of greater efficiency than the ordinary tungsten lamps. For a long time, it was found impracticable to improve the lamps much more than 10 to 20 per cent corresponding to an increased efficiency of only a few hundredths of a watt per candle-power. The melting point of the filament of a tungsten lamp although high, prevented any increase in efficiency more than 0.2 of a watt per candle-power. Beyond that figure the bulb blackened early and so reduced the candle-power and efficiency of the lamp. After long investigation and experiment, it was found that the only gas that caused blackening of the lamp bulb was water vapor. With this discovery came plans for eliminating this vapor, and the introduction of nitrogen vapor at atmospheric pressure into the lamp bulb was found to solve the problem.

PUBLIC UTILITY ACCOUNTING IN OREGON.

Instructions Pertaining to Uniform System of Accounts for Electric, Gas and Water Utilities.

(Concluded.)

14. **Plant and Equipment and Other Property Purchased.**—When any property in the form of a going or completed plant is purchased, an appraisal of the property so acquired should be made, and the different constituent elements of the plant (and equipment, if any) or other property acquired should be appraised at their structural value; that is to say, at the estimated cost of replacement or reproduction less deterioration to the then existing conditions through wear and tear, obsolescence, and inadequacy. If the actual money value of the consideration given for the plant or other property was at the time of the acquisition in excess of such appraised value, the excess should be charged to account "Other Intangible Capital," and the appraised value of the constituent elements should be charged to the appropriate fixed capital accounts as hereinafter designated. If the actual money value of the consideration given was not in excess of such appraised value, such actual money value should be distributed through the said accounts in proportion to the said appraised value of the constituent elements appropriate to the respective accounts.

Utilities should be prepared to furnish the commission upon demand, a full report of the contract of acquisition, the consideration given therefor, the determination of the actual money value of such consideration if other than money, the appraisal, and the amounts charged to the respective accounts for each plant or other such item of fixed capital purchased. The purchaser is required to procure in connection with the acquisition of any such plant or other item of fixed capital all existing records, memoranda, and accounts in the possession or control of the grantor relating to the construction and improvement of such plant and to preserve such records, memoranda, and accounts until authorized by law to destroy or otherwise dispose of them.

15. **Fixed Capital Withdrawn or Retired.**—When any tangible fixed capital acquired prior to July 1, 1913, is withdrawn or retired from service for any cause, the amount at which it stands charged should be credited to the sub-account under account "Fixed Capital Installed Prior to July 1, 1913," in which it is charged, and such amount plus the expenses incident to the retirement, less the value of salvage, should be charged to account "Reserve for Accrued Depreciation," for the proportion applicable to the period covered by the reserve, and to account "Realized Depreciation not Covered by Reserves" for the remainder. Such portion only of the realized depreciation shall be charged to account "Reserve for Accrued Depreciation," as is due to life in service during the period for which the reserve was established; this portion may be estimated on the basis of the proportion which the life in service of the property in question after that date bears to its entire life in service.

The entry of the credit to the fixed capital account should cite by name and page of book or other record the original entry of cost of the thing withdrawn. If there is no such original entry, that fact should be stated in connection with the credit entry, and the actual amount originally charged should be

credited. If such amount is not known, it should be estimated, the facts upon which the estimate is based and the name of the person by whom estimated should be shown, and the amount thus estimated to be equivalent to the original charge in respect of such thing withdrawn should be credited to the fixed capital account involved.

When any tangible capital acquired subsequent to June 30, 1913, is withdrawn or retired from service for any cause the amount at which it stands charged should be credited to the fixed capital account in which it is charged, and such amount, plus the expense incident to the retirement, less the value of salvage, should be charged to account "Reserve for Accrued Depreciation."

The entry of the credit to the fixed capital account should cite by name and page of book or other record the original entry of cost of the thing withdrawn.

If the age of tangible capital withdrawn or retired from service cannot be determined for classification between account "Fixed Capital Installed Prior to July 1, 1913," and account "Fixed Capital Installed Since June 30, 1913," the property so retired should be treated as having been charged to the former account, and the necessary credits should be made to the subaccounts thereunder.

When any fixed capital is withdrawn or retired whose book value as carried in the fixed capital account has been reduced by writing off estimated depreciation, only that part of the realized depreciation which has not already been written off should be charged to account "Reserve for Accrued Depreciation," or to account "Realized Depreciation Not Covered by Reserves."

When any fixed capital is withdrawn or retired whose book values is greater than the known or estimated cost such excess should be charged to account "Other Deductions from Surplus," and the realized depreciation should be charged as elsewhere directed.

If any fixed capital is sold for more than its original cost, the amount of depreciation, if any, accrued and credited to a reserve in respect thereof, should be determined as accurately as possible and charged to such reserve. The sum of the amount so charged and the excess of the selling price over the cost of the property should be credited to account "Miscellaneous Additions to Surplus."

16. **Operating Revenues Defined.**—By "operating revenues" are meant all amounts of money which the utility receives or becomes lawfully entitled to recover for services rendered and as the return upon property used by the utility in its own operations. Credits to the various revenue accounts should be based upon the gross charges made for services rendered by the utility. Discounts allowed for prompt payment, correction of overcharges, over collections theretofore credited and afterwards corrected, authorized refunds on account of failure in service, should be charged to the "Primary Revenue" account to which they relate.

Commissions paid to employes or others in lieu of salaries should be charged to the appropriate "Expense" accounts, and not to "Revenue" accounts.

17. **Operating Expenses Defined.**—By "operating expenses" are meant those out-goes (including capital consumed) necessary to the maintenance of the organization of the utility, production of the commodity sold and the services rendered and to the collection of revenue.

Except where some other meaning is clearly specified in the definition of the operating expense accounts the following words wherever used have the meaning as stated below:

"Cost, means cash or money cost and not price based on term of credit."

"Labor means human services of whatever character."

"Cost of Labor includes wages, salaries and fees paid to persons for their services."

18. **Repairs Defined.**—Repairs as herein used consist of ordinary and extraordinary repairs. Ordinary repairs include replacements of minor or short lived parts of structures, equipment, or facilities; replacement of minor parts of structures or equipment, made necessary by reason of faulty construction, excessive strains, mechanical injuries, or other minor casualties not provided against in charge for depreciation of plant and equipment; rearrangements and changes in location of equipment (except consumers service equipment), etc. Ordinary repairs are not required to be taken into account in fixing a rate of depreciation. Extraordinary Repairs include restoring to an efficient or proper condition, buildings, structures, or other units of property which have deteriorated; substituting, in order to maintain normal efficiency, new parts for old parts of continuous structure, such as pole line, cables, wires, conduits, pipe lines, etc., where such substitutions do not amount to a practical replacement of any considerable length of such continuous structures; restoring the condition of property damaged by storms, floods, fire, or other casualties; recovering salvage and removing retired or abandoned property in connection with the above kinds of work.

Extraordinary repairs should be provided for by adequate charges to depreciation. When it is necessary substantially to reconstruct or to replace a major portion of any unit of property or any important section of a continuous structure, the cost should be handled through the Capital account; that is, the cost of property removed or replaced should be credited to the appropriate Fixed Capital accounts, and the new property should be charged thereto.

All repairs whether ordinary or extraordinary should be charged to the appropriate "Primary Operating Expense" accounts. Extraordinary repairs which have been provided for by adequate charges to depreciation should be concurrently charged to account "Reserve for Accrued Depreciation" and credited to account "Repairs Charged to Reserves—Cr."

19. **Cost of Repairing.**—Cost of repairing includes all wages, salaries and fees, paid employes directly engaged in the work of repairs; personal expenses of such employes when borne by the utility, the cost of material and supplies consumed and the expense of facilities employed in making the repairs, less the value of any salvage. It includes also the cost of direct supervision, such as foremen or superintend-

ents of repair gangs, but does not include the cost of general supervision.

20. **Depreciation of Plant and Equipment.**—Utilities should include in operating expenses depreciation charges for the purpose of creating proper and adequate reserves to cover the expenses of depreciation currently accruing in the tangible fixed capital. By "Expenses of Depreciation" is meant the losses suffered through the current lessening in value of tangible property from wear and tear (not covered by current repairs); obsolescence or inadequacy resulting from age, physical change, supersession by reason of new inventions and discoveries, by changes in popular demand or in public requirements; losses suffered through destruction of property by extraordinary casualties. The amount charged as expense of depreciation, should be based upon rules determined by the accounting utility. Such rules may be derived from a consideration of the utility's history and experience. Utilities should be prepared to furnish the commission upon demand, the rules and a sworn statement of the facts, expert opinion and estimates upon which they are based. The estimate for depreciation of physcal property should take into account: the deterioration and ultimate retirement of units of property which may be satisfactorily individualized, such as buildings, structures, machines, units of equipment, valuable instruments, etc., to the end that by the time such units of property go out of service there shall have been accumulated a reserve equal to the original money cost of such property plus expenses incident to retirement less the value of any salvage. The depreciation accruing in property which cannot be readily individualized, such as pole line, wires, cables, conduits or other continuous structure, where expenditures for repairs or replacements of individual parts ordinarily are not actually made until the later years of the life in service of such property and when made may, therefore, be classed as "Extraordinary Repairs."

The rate of depreciation should be fixed so as to distribute as nearly as may be, evenly throughout the life of the depreciating property, the burden of extraordinary repairs, and the cost of capital consumed in operations during a given month or year, and should be based upon the average life of the units comprised in the respective classes of property.

The amount estimated to cover the expense of depreciation should be charged monthly to account "Depreciation of Plant and Equipment," and concurrently credited to account "Reserve for Accrued Depreciation."

Account "Realized Depreciation Not Covered by Reserve" is provided in the "Corporate Surplus or Deficit" account for charges for realized depreciation on tangible fixed capital retired, when such depreciation accrued prior to the establishment of account "Reserve for Accrued Depreciation," or has not been provided for by credits to that account.

21. **Extraordinary Casualties and Unanticipated Reconstruction.**—If so authorized, upon application to the commission, the utility granted such authority may charge the amount named in the authorization to a "Suspense" account for the purpose of distributing over a limited period, an extraordinary loss of such a nature that it cannot be anticipated by the exercise of reasonable prudence. Losses of this sort may be due to the requirements by lawful authority or public necessity for improvements involving the abandonment of a considerable portion of plant and equipment before it has attained its normal life in service, or to an extraordinary casualty entirely unforeseen and unprovided for. The original cost of the property so abandoned or destroyed, should be credited to the "Fixed Capital" accounts, in which it was carried, and such portion of the cost as may be authorized by the commission may be charged to the "Suspense" account. The remainder of the cost less any salvage, being charged out as eleswhere provided in case of retirement of property. The "Suspense" account so raised should be credited and account "Extraordinary Depreciation" debited monthly with such an amount as will through its regular application amortize the amount of the loss at the end of the period designated. All ordinary casualties (those which occur with such frequency that the principles of insurance are applicable thereto) should be provided for through an insurance reserve maintained for such losses, or be included in the provision for depreciation of plant and equipment.

22. **Apportionment of Revenues.**—Revenues derived from a particular service shall be credited directly to proper revenue account prescribed herein. Where a lump sum is received for two or more utility services, and the agreement of sale does not specifically set forth the price of each, unless otherwise provided in the text to accounts, the amount may be apportioned on equitable rules determined by the accounting utility. Utilities will be required to show in annual reports to the Railroad Commission, the revenue received from each municipal corporation and quantities of the respective commodities supplied, also similar information with respect to commodities sold other utilities for redistribution and sale; all revenue from without the state; revenue derived from service within the state subdivided so as to show total revenue and quantities by each city, town or village.

23. **Apportionment of Expenses.**—Expenses shall be localized to Oregon where such localization can be equitably made, those common to operations in two or more states may be apportioned, unless otherwise specifically ordered, on equitable rules determined by the accounting utility. Localize expenses due to the rendition of service in each city, town, or village within Oregon with view to convenient analysis when required.

If more than one plant is operated; different facilities or processes used for production of commodity sold; joint utility services rendered; or other business is engaged in, direct expenses shall be appropriately localized; expenses not capable of localization may be apportioned on equitable rules determined by the accounting utility.

24. **Equitable Rule Defined.**—By "Equitable Rule" is meant bases and formulae, determined by current tests or by statistical data from past experience that will justly apportion the joint revenue or expense burden not arbitrarily fixed percentages (i. e., 50 per cent, 25 per cent, 20 per cent, 5 per cent), unless justifiable by facts in the case. Nothing in the way of rents shall be charged by one department to another department in the same utility for the use of plant or equipment.

FIRES AS A CAUSE OF SHORT-CIRCUITS ON HIGH VOLTAGE LINES.

BY J. C. CLARK.

In the summer of 1912, persons interested in the construction and operation of a high voltage power transmission line which traversed a public park applied to the board of park commissioners for permission to clear away shrubbery from the ground

Fig. 1. Showing Manner in Which First Test Was Made.

beneath the line in order to prevent possible damage to the line from fires. This permission was refused, and a dispute subsequently arose over the question as to the possibility of short-circuiting the line by flames occurring in the shrubbery. In order to throw light upon the matter certain tests were conducted at Leland Stanford Junior University by Professor H. J. Ryan, and the writer in November, 1912, and February, 1913, for the purpose of demonstrating whether or not it is possible to short-circuit such a line through the agency of flames between and around the wires.

It may seem to some that, from our knowledge of the work of the electro-physicist in studying the conduction of electricity through gases, no experiments were necessary to demonstrate the ability of flames to produce short-circuits. The writer believes, however, that experiments like the present have particular value in being on a sufficiently large scale to indicate beyond doubt to the man engaged in the practice of electro-technology what may be expected in that practice; whereas, the laboratory achievements of the physicist are quite commonly of so refined and delicate a nature that it is difficult for the layman to project their significance into engineering practice.

Fire-tests were conducted by two methods. In the first test, two No. 10 copper wires were stretched 30 in. apart, and 5 ft. above the ground. These were insulated from ground, and from each other, and high voltage was applied to them from a source having its middle point grounded. A pine wood fire was built on the ground under the wires so that the bright flames filled the space around and between the wires. A photograph (Fig. 1) was taken to show the manner in which this test was carried out. Portable instruments were inserted in the low-voltage supply to the high-voltage transformers, and readings were made of the voltage, current, and power taken by the fire. Current and power fluctuated violently over a wide range.

In the second fire-test, the fire was built upon a platform approximately 6 ft. sq., insulated from the ground, (Fig. 2). This platform was covered with earth; sheet iron was then laid over the earth, and the wood for the fire was piled upon the iron. A pipe-frame 5 ft. sq. was covered with wire netting and was suspended with its plane parallel to that of the platform while its distance above the platform was made adjustable over a considerable range. High voltage from the same source as used in the first fire test was applied between this square of netting, and the sheet-iron at the base of the fire.

In both tests it was evident from the instrument readings that the flames conducted much current at all times directly between the terminals used, but the striking feature of both tests was the manner in which the current "cored up" intermittently into bright, thin streams of conduction, immediately pro-

Fig. 2. Showing Test Fire Insulated From Ground.

ducing short-circuits. These cores appeared in a very irregular manner, which was clearly due to the great, and continuous, variations in the amount, and disposition of the flames between the wires.

The following data were taken during the second fire tests, and show in a general way the electrical behavior at such times that readings were possible. It should be borne in mind that a great many short-circuits occurred throughout the progress of the test, and it was impossible to secure a satisfactory record of these:

Volts at Fire.	Milli-amperes through Fire.	Watts input to Fire.	Remarks.
108,000	7.96	860	Flames 18 in. to 24 in. above screen; 2 ft. of fire from wood to screen.
108,000	5.46	590	
115,000	2.09	240	
104,000	9.62	1000	Screen 4 ft. 6 in. above wood, and at the top of flame-tips.
108,000	2.87	310	
108,000	4.35	470	
108,000	3.70	400	
108,000	4.72	510	Tips of flame thinning as they hit screen.

It is clear to all who witnessed the tests that flames will readily produce short-circuits between

high-voltage conductors; and it is believed that this fact is of considerable importance in the cases where, for any reason, it is not possible to clear the ground of brush or timber beneath such lines, and where such material is capable, in burning, of laying a flame across the wires.

RECENT REGULATORY MEASURES AFFECTING PUBLIC UTILITIES.

BY O. B. COLDWELL.

(The author of this paper describes the gradual awakening of public utilities to the fact that their business had a special relationship to the public, their acceptance of commission control and its value in assuring a square deal to all. He then describes the various commissions, their work and purposes, and the methods they employ. This paper was presented by Mr. Coldwell at a recent joint meeting of the Portland Sections A. I. E. E. and N. E. L. A.—The Editors.)

It is not not very long since the officers of public utility companies looked upon their business in the same way that the ordinary business man looks upon his business. Had you suggested to the public utility official that his concern was a semi, or quasi-public institution, and therefore he must submit to certain restrictions upon his methods of doing business, he would not have agreed with you. He had been accustomed to regarding his business in the manner of the ordinary business man. There was a scale of rates, to be sure, that was pretty generally adhered to, but special discounts and other devices were in vogue, for the purpose of securing business the same as they were and are in vogue in other lines. This is all changed. Gradually the central station fraternity has been led up to the belief that its business is no longer a private business. They have been getting used to the idea that public utility companies are in a large measure the servants of the public, in fact, to believe that the public must be considered before anything else. They now take kindly to the idea of regulation by commissions and have actually begun to believe that it may be the best thing after all. The technical journals of today are largely devoted to the investigations which are being made, decisions rendered and regulations promulgated by public utility commissions. We are all imbued with the idea that the regulating commissions are bodies created expressly for the purpose of seeing that everybody, including the utilities themselves, gets a square deal.

The most prominent regulating body of the kind in question is the interstate commerce commission. This particular commission has to do principally with the main line railroads of the country and enters into all of the relations which these roads have with the public. The findings and rulings of this commission have become widely known and it has, in a large measuse, set the pace in methods of procedure which are being followed by the various state commissions. While the interstate commerce commission has already undertaken some weighty tasks, it is at present about to enter in on a piece of work which will be by far the most important yet undertaken by it. I refer to the valuation of the properties of the main trunk railroads of the United States. This will be a work of great magnitude and will no doubt engage the attention of the commission for several years to come.

The state railroad and public utility commissions are likewise important regulatory bodies, and as they deal with light and power, gas, water, telephone, telegraph and street railway companies, as well as the trunk railways of their individual states, the public utility people generally are perhaps better acquainted with the state than they are with the interstate commission. These commissions have now been created in many of the states, and an immense amount of work has been accomplished by them in investigating every phase of the utility companies' business and the relation of such companies to the public.

In addition to these commissions, there are other bodies which to a greater or less degree have to do with the carrying on of a public utility company's business, such as the department of public utilities of the city, the board of fire underwriters, public safety leagues, health boards, state bureau of labor covering factory inspection, state water board, etc., in fact, it would seem that the different commissions and special boards are here to stay and that these bodies, national, state, municipal, civic or otherwise, are destined to take a hand in the regulation and handling of our public utility companies. It is not my purpose to do any more than merely mention these various bodies and designate in a general way what they aim to do.

In this state, the railroad commission with jurisdiction over the utility companies, has recently approved a uniform classification of accounts for light and power, water and gas utilities. This classification of accounts embodies some of the latest ideas on the subject of accounting for utility companies and aims to have the accounts themselves expressive of the various operations performed by the utility in rendering the diversified classes of service it renders.

The commission has likewise issued a tentative set of regulations governing the methods of measuring amounts and quality of service furnished by electric, gas and water companies.

The commission at the present time is engaged in the preparation of certain rules which will have to do with pole line construction throughout the state.

The methods employed by the commission in undertaking work of this kind are worthy of mention. In each case the various utility companies are invited to participate in the preparation of the regulations under consideration for the purpose of securing measures which will be as complete and satisfactory as possible, and it may be remarked that there is in general a hearty co-operative spirit manifested by all concerned.

At the present time there is in course of preparation in conjunction with the public utility department of the city of Portland, a joint pole agreement which it is confidently expected will be of benefit to the public and likewise to the companies operating in the city.

The railroad commission has been working for some time on certain rules pertaining to the standardization of line construction in the state and making safer some features of such construction, especially crossings, etc. Other regulations of the commission pertain to station construction. In conclusion, I will say that it has been my observation that all public utility companies in this section have an ear to the ground in an endeavor to be up to date on all matters pertaining to the proper conduct of their business and are in a remarkable degree ready to cooperate with any of these regulatory bodies in an endeavor to secure better results.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advanace of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1900.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

System of the Mt. Whitney Power and Electric Company... 575
By Rudolph W. Van Norden.

Mineral Production in Utah..... 607

"Partnerships vs. Principal and Agent" in Public Utility Rate-Making 607
By J. F. Dix.

The Nitrogen-Filled Electric Lamp..... 609

Public Utility Accounting in Oregon..... 609

Fires as a Cause of Short-Circuits on High Voltage Lines... 612
By J. C. Clark.

Recent Regulatory Measures Affecting Public Utilities..... 613
By O. B. Coldwell.

Editorial 614
Competitive Telephone Service.
Retrospect and Prospect.
The People Profited.

Personals 616

Meeting Notices..... 616

Examination for Laboratory Assistant (Male)..... 617

Pacific Coast Gas Association..... 617

Trade Notes..... 618

New Catalogues..... 618

Industrial 619
The Largest Electric Hoist.
Pioneer Electric Locomotives in Alaska.

News Notes..... 620

Competitive Telephone Service

One of the most important occurrences at the passing of the old year is the thawing out process of the icy isolation of the American Telephone & Telegraph Company. Hereafter physical connection for independent companies with that system for the delivery of messages to places other than that of origin will be possible throughout the nation; the advantages of competitive telephone conditions have been created.

At practically the same time that the Federal government made public the reorganization plans of the American Telephone & Telegraph Company, which includes these provisions, a decision of interest was rendered by the California Supreme Court relative to a suit brought by the Pacific Telephone & Telegraph Company against the Railroad Commission of California.

This suit grew out of the commission's order compelling the Pacific company to make physical connection to certain competitor's lines so that their subscribers might use the Pacific company's toll lines for long distance conversations.

Although the commission had fixed rates for this service its order was annulled as it was conceded that no compensation had been given for the act of forcing the Pacific company to share its system with rival companies. The court took the view that the ruling of the commission was not an act of justifiable regulation and control but a taking and using of the Pacific company's property without compensation; a violation of the Constitution of the United States.

In the reorganization plans of the American Telephone & Telegraph Company no provision appears to have been made for reimbursement for the use of its system by competitive companies other than the collection of regular toll charges, and this ruling is therefore a matter of added interest on that account.

This reorganization plan originated with the company and its purpose was ostensibly to avoid litigation which would probably have resulted in the enforced dissolution of "the telephone trust."

The company's action is one more indication that public utilities are more than ever inclined to cooperate with the public in mutual interest partnerships; they are awakening to the fact that their part is to serve the public; that they profit most in this way.

The public intend to be served competently and with fairness; the honest utility will be protected.

The agreement made will not, it is said, affect the suit entered several months since to dissolve the connection of the American Telephone and Telegraph Company with the Pacific Telephone and Telegraph Company which suit will be pressed by the government to determine how far the Sherman anti-trust act applies to telephone companies. On the other hand, it is confidently affirmed by officials of the Pacific Company that the Government through acceptance of the offer of the parent company now has no grounds for its complaint that the combination is one which is in restraint of trade.

Retrospect and Prospect

The New Year comes to the electrical industry with the promise of improved business conditions; hastened by the facility of adjustment, resourcefulness and enterprise of the American people. During the year just passing the national business load curve showed too deep a valley of financial depression, but the new year finds the trend upward. That the complete cycle of operation will bring the inevitable peak of business is the promise of the New Year.

On the Pacific Coast during the past year has been built into its history a record of achievement. Projects unattempted elsewhere have here been accomplished. Generating units have been increased in size and records broken only to be immediately broken again, higher voltages have been successfully used for transmission over longer distances; efficiencies have been generally improved and new uses found for electrical energy.

Into the promise of the New Year is projected the business impulse back of concentrated and co-operative effort along broader lines than have heretofore been considered, and under more auspicious circumstances and conditions than have ever before heralded such a united purpose. The past year has been one of remarkable growth, despite untoward conditions, and prospects for the future are even better.

Withal the relationship between the public and the public utility has through the medium of commission control been placed upon a firmer footing. This rests upon the common basis of complete utilization, which includes maximum service at minimum cost, and a square deal for all.

Under these conditions capital is easier, is being attracted more readily to public utility enterprises and especially to those in the West.

The feeling of Optimism, well-founded, is growing—and why not? The mineral output of all Pacific Coast states shows remarkable increases, the promise of good crops is virtually realized; the lumber industry is operating at full capacity; and with money firmer and all other business feeling confidence in an assured growth and development there is arising a wave of confidence which should sweep the West with prosperity.

So closely interwoven with the success of forest, farm, city and field is the success of the electrical industry that this consequently obtains also. Business conditions for the New Year are promising.

The People Profited

If a crop season passes and the tillable land is not cultivated a source of wealth is wasted. Underground water supplies unless raised to the surface of the ground and utilized are valueless. The mountain torrent in the heights which are silent save for the sound of its tumbling downward, is of value to none. But harnessed and applied to the pumping of water to the thirsty land it is of great service to man. Then follows the miracle and the desert blossoms as a rose. This illustrates conservation by wise utilization.

In the east half of the San Joaquin valley of central California, foresight and enterprise have combined these forces and secured the predetermined results. The hardship and uncertainty of dry-farming has fast given way to the cultivation of more varied, more prolific and more profitable crops. A development which is remarkable is the result.

It might have been feasible to use simple means, such, for example, as the shadoof of the Egyptians operated by one man power. But neither the crudities of inefficient hand operation or even gasoline or steam power pumping could have accomplished so much even if progress could have been made at all. Here as a result of the happy combination of a good soil and climate together with cheap hydroelectric power and a reliable supply of underground water man is able to raise practically any crop which the market demands.

Cities and towns, and necessary transportation facilities have sprung into existence as a natural consequence of this successful agricultural development, which in turn depended upon the initiative and enterprise of the Mt. Whitney Power & Electric Company. The improved conditions and service and the increased values which that corporation made possible places the public served forever a debtor.

That the public may prove a perpetual beneficiary argues against the especial taxation of private corporations which as public utilities properly develop water power sites, merely on the ground that they are utilizing the otherwise valueless property of the public. The people benefit most.

The Mt. Whitney Power & Electric Company has 1262 miles of transmission and distribution system which reaches to practically every part of the territory served. Yet there is but 8½ per cent of the 1,000,000 acres of tillable soil contiguous to this network of power lines, brought under cultivation. The possibilities are vast.

There is an average of nine and one-half horsepower in motor load to every mile of power line. The pumping load for which the system was designed, now absorbs 70 per cent of the kilowatt-hour output of the plant. This plant, together with the reconstruction now under way aggregates 33,000 horsepower.

The equitable system of charging for power is especially noteworthy as it encourages cultivation of the small as well as of the large tract of land.

The population now served by this company has increased to 60,000 and there are naturally many industries springing into existence to cater to the needs of this growth.

One of the remarkable engineering features in this system is the bench construction of part of the conduit of formed concrete slabs. These slabs were molded and then hauled into place from the point of manufacture, the bottom of the conduit being mixed on the ground except where elevated in which case the horizontal slabs are also molded.

There is one other point to be made in passing. Just as the steam engine first brought country folks together into cities that they might work in factories at machines utilizing centralized power, so now the electrical distribution systems of central stations invitingly reaching out into the agricultural districts with their promise of city comforts and conveniences on the farm, are appropriately encouraging the return of the people to a more desirable country life.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Paul Shoup, president Pacific Electric Railway Company, Los Angeles, is at San Francisco.

F. H. Welling, Pacific Coast manager Federal Sign System, was at Los Angeles last week.

F. Baker with J. C. English Company, Portland, was at San Francisco during the past week.

C. I. Kephart, commercial engineer Sierra and San Francisco Power Company, is at Los Angeles.

H. A. Kluegel, chief engineer Mt. Whitney Power & Electric Company, paid a visit to San Francisco last week on company business.

G. M. Gest, engineer and contractor, announces the removal of his executve offices to suite 1330-36, Woolworth Building, New York.

A. D. Hotson of Vancouver, British Columbia, has been elected to the grade of member of the American Institute of Electrical Engineers.

F. D. Fagan has been appointed sales manager of the San Francisco office of the Edison Lamp Works of General Electric Company.

Henry T. Scott, chairman of the executive board, Pacific Telephone and Telegraph Company, has returned to San Francisco from Washington, D. C.

L. Tenney-Peck, president First National Bank of Honolulu and of the Honolulu Electric Railway Company, passed through San Francisco last week en route home from Washington, D. C.

C. L. Cory, professor of electrical engineering at the University of California, Berkeley, has been appointed local representative of the Board of Examiners of the American Institute of Electrical Engineers.

H. F. Holland, intermountain representative of the Simplex Electric Heating Company, left Salt Lake City last Saturday to spend the holidays with his family in Boston, Mass., and also to make his annual visit to the Simplex factory at Cambridge.

R. F. Hayward, Western Canada Power Company, Vancouver, B. C., was appointed local representative of the Board of Examiners of the American Institute of Electrical Engineers at the meeting of the Board of Directors, held December 12th.

J. B. Sunderland, who has filled an important position in the comptroller's department B. C. Electric Railway Company, Vancouver, B. C., will sever his connection with that company to take charge of the agency department, Macdonald, Marpole & Company in that city.

G. I. Kinney, Pacific Coast manager for the Fort Wayne Electric Works and the Sprague Electric Works of the General Electric Company, has returned to his San Francisco offices after an extended trip through the East, having returned by way of Seattle and Portland.

L. M. Wood, for the past seven years purchasing agent of The Wesco Supply Company, St. Louis, Mo., has resigned to become sales manager of the Menominee Electric Manufacturing Company, Menominee, Mich.

E. J. Barry has opened offices as consulting and construction engineer in the Tacoma Building at Tacoma, Wash. Mr. Barry is well known as a specialist on the application of electricity to the lumber industry, having but recently completed a great work of this character for the St. Paul & Tacoma Lumber Company.

F. G. Baum, chief engineer Lake Spaulding Development, Pacific Gas & Electric Company, was the guest of honor at a banquet tendered to him at the St. Francis Hotel last Friday. The heads of departments interested in this development, representatives of those firms supplying machinery and materials and several prominent engineers were present. The guests numbered 175.

John Coffee Hays and **H. T. Hays** of the Mt. Whitney Power and Electric Company of Visalia; **A. Emory Wishon**, **E. B. Walthall** and **E. D. Farrow** of the San Joaquin Light and Power Corporation; **Whitman Symmes**, mine manager of Virginia City, Nev., and **L. F. Youdall**, electrical contractor at Stockton, Cal., were out-of-town participants in the "wasshael" luncheon at San Francisco on December 20th.

MEETING NOTICES.

Los Angeles Engineers and Architects' Association.

This association held its regular meeting at the Hollenbeck Cafe on Thursday evening, December 18th, when Ralph J. Reed presented an interesting paper on "Oil Transportation in California." There was a good attendance.

Utah Society of Engineers.

An interesting discussion on "Good Roads" was given at the regular monthly meeting of the Utah Society of Engineers Friday, December 19th, in the Stock Exchange Building. Papers on this important subject were presented by E. R. Morgan, State Road Engineer; Richard R. Lyman, vice-chairman of the State Road Commission; and Arthur E. Fox, purchasing road engineer of Boise, Idaho.

A. I. E. E. Directors' Meeting.

At the board of directors' meeting held in New York on December 12th, Section 51 of the Institute by-laws, limiting Section territory to points within sixty miles of the meeting place of a Section, was amended upon the recommendation of the Section's committee, so as to permit the board of directors to extend this territory in cases where such extension is warranted by conditions such as obtain with some of the Pacific Coast Sections.

The Standards Committee reported recommending the publication in the proceedings of the preliminary report of the Joint Rubber Insulation Committee, an unofficial body representing various manufacturers and users of rubber compounds, which has been at work for two years preparing a standard specification and analytical procedure for 30 per cent Hevea rubber insulating compound.

Los Angeles Section A. I. E. E.

Members of the Los Angeles Section of the American Institute of Electrical Engineers will inspect the local telephone exchanges on Monday evening, December 29th. It is proposed to meet at the exchange of the Home Telephone & Telegraph Company at 8:00 p. m. Mr. Keller will give an informal talk on the automatic system. Later, the members will visit the main exchange of the Pacific Telephone & Telegraph Company, where Mr. Dix will take charge of the party.

For the January meeting of the Los Angeles Section of the American Institute of Electrical Engineers, Mr. P. S. Taylor of the Riverside-Portland Cement Company, will present a paper on "Precipitation of Dust from Rotary Cement Kilns."

Utah Electric Club.

At the regular luncheon of the Utah Electric Club at the Commercial Club Thursday, December 18th, W. C. Stark, Assistant Secretary of the Commercial Club of Salt Lake City, presented some figures which have been compiled by the club as to the proposed one million dollar bond issued by the County Commissioners of Salt Lake County for the installation of a complete system of good roads. He showed what other States, particularly California, had done in this respect. After a rather spirited discussion the club passed a resolution memorializing the County Commissioners as favoring this bond issue and urging them to take immediate steps to have the necessary election to provide this money.

The ball given by the Utah Electric Club at the Majestic Dancing Pavilion Friday, December 19th, was declared to be the most successful social event the club has attempted. Special street car service to the pavilion was provided by the

Utah Light and Railway Company, and every detail necessary for the smooth running of an event of this character had been carefully attended to by the Social and Entertainment Committee under the direction of W. W. Torrence, chairman.

Wass-hael Luncheon.

Agreeably to invitation about two hundred and fifty electrical and machinery men assembled at luncheon in a San Francisco cafe on Saturday afternoon, December 20th. Here was celebrated with true Christmas spirit a revival of the old English custom of "wass-hael," or wassail. This third annual luncheon was presided over by T. E. Collins, who with the generous assistance of an able committee had "counselled with ye cooks and kellermen in making choice of ye victuals more delectable and wynes more mellow than hath ever been served in all Britain." Pipers and fiddlers dispensed lively airs and many talented fellows entertained with their song, music and stories. Among those present were:

Affolter, P. H.
Allen, Bert
Baker, F. D.
Baker, J. S.
Barker, G. L.
Beardsley, E. W.
Beattie, Cliff
Benchley, W. W.
Bendel, W. T.
Bibbins, T. E.
Bivins, W. T
Black, Jos.
Bragg, I. H.
Bridges, J. E.
Briggs, A. G.
Briggs, Herbert F.
Briggs, W. W.
Brittingham, Walter
Brooks, Fred
Bulotti, Chas.
Burden, F. A.
Burton, M.
Butler, W. W. S.
Butte, C. F.
Cameron, Ewen
Carter, H. V.
Chapman, H. F.
Clinton, W. J.
Cole, Waldo
Collins, Geo. C.
Collins, T. E.
Cook, C. B.
Cook, M. H.
Cooper, N. K.
Corvin, Harry
Craig, Wm.
Crilly, Jas.
Crosby, J. W.
Curtis, Geo. H.
Daley, H. H.
Degen, Tom
DeLancie, H. S.
DeRemer, J. G.
Dodd, W. G.
Douglass, R. L.
Dredge, Theo.
Drendell, Al.
Dunbar, F. A.
Dunbar, W. R.
Eltringham, Robt.
Enright, Frank R.
Ettienne, Emil
Farrow, E. D.
Ferris, Capt. Frank
Fowden, Frank
France, R. L.
Froding, Chas.
Gillis, Samuel
Goodwin, Wm.
Gregory, S. B.
Gribble, E. C.
Grigsby, Chas.
Griswold, A. E.
Hacke, H. C.
Hagedorn, Geo.
Halloran, A. H.
Hammersmith, A.
Hand, Harry
Hand, Roy
Hanbridge, W. S.
Hanford, Albert
Hardie, L. N.
Hardy, C. E.
Harkness, H. L.
Harper, S. L.
Harriman, M. A.
Harris, Dave
Hartzell, H. F.
Harvey, A. M.
Hawkins, A. J.
Hawkins, S. L.
Hays, Harry T.
Hays, John Coffee
Hays, T. A.
Heath, J. G.
Heise, C. E.
Heifrich, L. C.
Henry, Geo. J.
Herbert, Al
Herbert, C. D.
Herr, Bennie
Herzog, Mel
Hess, V. E.
Hillis, Chas.
Holabird, Russ
Hughes, H. H.
Hunt, E. A.
Hussey, H. A.
Hutchinson, Eli
Irwin, A. M.
Jackson, H. F.
Johnson, Sam
Johnson, W. C.
Jones, G. D.
Jones, H. T.
Joy, A. C.
Kahn, Axel
Keenan, Walter
Keene, R. E. G.
Kendall, E. J.
Kephart, C. C.
Kerr, L. B.
Killam, C. L.
Kimball, G. E.
Knapp, J. E.
Laumeister, Chas., Jr.
Le Coste, Dr. Henry
L'Hommedieu, W. P.
Lindsay, Robt.
Linge, C. W.
Maden, Emil
McAlmon, H. R.
McCants, M.
McCarthy, E. H.
McCord, O. P.
McDonald, R. F.
McKinley, W. L.
McLean, Jos.
McNeilly, Robt.
McNulty, F. W.
Miller, Frank
Miller, N. B.
Moitoza, A.
Moldrup, E. J.
Moore, Pierre C.
Moore, Dr. H. W.
Morris, T. C.
Murphy, Chas.
Nadon, J. A.
Nott, L. A.
Odell, L. L.
Otterson, N. E.
Paddock, Paul
Pahl, A. J.
Peterson, M. B.
Pottinger, J. J.
Pounder, W. H.
Quarg, R. F.
Quinn, E. A.
Ramsdall, R. A.
Rhine, M.
Robb, R. T.
Robinson, J. I.
Robscheidt, Hans
Rosenlund, E. T.
Rowe, A. E.
Rowe, J.
Russell, Sam
Sanderson, Jack
Schessinger, O. A.
Schloss, E.
Scobey, M. L.
Searight, Harvey
Seaward, G. A.
Seller, H. J.
Shepard, Wm.
Sherman, H. E.
Shields, C. E.
Shreve, E. O.
Somers, L. A.
Sproul, E.
Squires, H. B.
Squires, W. D.
Stateler, T. M.
Steele, Miles
Stilger, Geo.
Summers, Frank
Sutton, Chas.
Symmes, Whitman
Talbott, J. A.
Thompson, Joe
Thrall, Fred
Tilton, R. F.
Tobey, J. O.
Tubbs, L. C.
Victors, E. A.
Von Huysen, Jack
Wainwright, Jas.
Walthall, E. B.
Ward, L. T.
Ward, Wm. D.
Warren, E. E.
Watson, R. W.
Webster, Fred L.
Wedgewood, D. R.
Wemer, F. E.
Werner, W. F.
West, J. C.
Whaley, Edward
Wheeler, Frank
Williams, G. I., Jr.
Wilson, F. W.
Wishon, A. Emory
Wolden, R. L.
Wolf, H. S.
Woodbridge, J. E.
Wright, Chas.
Wright, Wm., Jr.
Youdall, L. F.
Young, Garnett
Youngholm, Al
Zoffman, F. P.

EXAMINATION FOR LABORATORY ASSISTANT (MALE).

On January 21 and 22, 1914, the United States Civil Service Commission announces an examination for laboratory assistant in the Bureau of Standards, Department of Commerce, Washington, D. C., at salaries ranging from $900 to $1200 a year.

The Bureau of Standards is engaged in research and testing of weights and measures, standards, measuring instruments, and materials. The work is similar to that in the better class of industrial and scientific research laboratories. Experience has shown that the probability of appointment of qualified eligibles is excellent. Advancement is through a series of graded positions to the grades of assistant physicist, associate physicist, and physicist. The Bureau possesses a valuable scientific and technical library in physics, chemistry, and engineering, and the facilities for its work are unexcelled.

Competitors will be examined in general physics, French or German, practical questions on each optional subject chosen, education, training and experience.

PACIFIC GAS ASSOCIATION.

(The following discussions are abstracted from the proceedings of the Pacific Coast Gas Association, 1913. The subheads are the names of the papers discussed, all of which have apepared in previous issues of this of which have appeared in previous issues of this journal.—The Editors.)

The Industrial Fuel Situation.

Van E. Britton:—There is often a lack of unity of purpose between industrial departments of the gas company and the engineering departments and the operating and maintenance departments. If it were possible to get those various departments under one directing head, a great deal more good could be accomplished for all departments. The trouble has been that the operating department has seemed to feel that its purpose and scope of work was completed when the gas was put into the street main. The sales departments were left entirely to their own resources towards developing the future sale of that product. The result is that there was no harmony, no integrity of purpose, between those departments, with the result that they were pulling away from each other. The industrial men often blamed the operating department for the poor results obtained, where if it had been possible for one department to be responsible the blame, if any, could be placed where it belonged. Often poor appliances are sold by dealers who are looking for profit on the individual sale and care nothing for the maintenance or the final results obtained by that particular appliance. It is a mistake for gas companies to permit the installation of an appliance that is not properly built for the work intended. If they were to exercise some sort of supervision over the installation of all appliances intended for the burning of their particular product, a supervision that would extend to the point of an advisory capacity by their industrial engineers for the industry for seeing that the appliances installed for some particular purpose was the very best possible appliance which could be secured for that individual purpose, the results would be a great deal better for the reason that the consumer himself would become the salesman for the company, advocating the installation in some instances of some similar type of apparatus.

I call to mind an industrial concern in San Francisco that called upon me about a year ago for an estimate for building a gas making unit to supply their factory with gas, they being off from the main lines some distance. The information had not reached the commercial department, or, if it had, had not received the attention it deserved. Some arbitrary price was set and the matter was dropped. These people, realizing the benefits of gas over coke and crude oil, resolved to build a plant themselves. They found, however, that the cost of installing a generating plant was out of question. Even a similar amount for main extensions would give them a very much better supply and a very

much lower cost. The industrial department evidently got in touch with these people, and the result is that at present the main extension has been made for these people's plant and they are now using a very large quantity of gas monthly which is quite an added revenue to the company. These people with their competent engineers realized the benefit of fuel gas, but seemed to think that it was out of the question for them to secure the gas from the local distributing company. There is a matter that comes up to the publicity department. Therefore it seems to me that each of the different departments of a gas company is an integral part, each one radiating from the hub, which, of course, is the general manager. All those various spokes of the wheel are as essential to the proper work of the company in securing the ultimate results in dividends to the stockholders as any other part. The operating department is no more important than the sales department, nor is the sales department more important than the publicity department. It is to the sales department particularly that the final disposition of the product is due. Unless their efforts are directed toward the disposition of that product, no matter how cheaply the product may be produced in the generating plant, it is of no value to the stockholders. If it is possible the sales department should see that all possible appliances, no matter of what particular type or construction, should be thoroughly investigated and presented to the public in a way that will meet their approval and attention. In some of the larger cities in the East there are large stores devoted to the proposition of giving to the manufacturers the various appliances, and particularly to make a permanent supply, very much like the place in Philadelphia where machinery merchants are given an opportunity to display their wares. If such a thing is possible and the companies for the manufacture of all appliances will have an opportunity to install a permanent display where the public can be courteously received and treated, where the little niceties of life can be presented to them, will draw the public in to see the new developments in the business. When that time comes there is going to be a tremendous stride in the sale of all sort of gas and electric appliances. There are a great many things on the market in both lines that are unknown to the public at large. For example, to recite a little personal incident, when my baby was born it was up to me at 2 o'clock in the morning to go down into the kitchen, light a gas fire, heat some water, boil a bottle of milk and bring it back. The time elapsed was about 15 minutes, as a rule. In the meantime baby was crying very hard and mother was getting very nervous. I happened to go into an appliance store in San Francisco and saw an advertisement of an electric nursery bottle heater. I had never heard of such a thing, although I had directly or indirectly been connected with gas and electric appliances. I immediately purchased one, the result being that at the first peep from the baby we simply pulled the chain switch and by the time the baby was awake and ready for the bottle the bottle was ready for the baby.

Report of Committee on Gas Engineering Degree.

E. C. Jones:—The work accomplished last year at the University of California showed beyond a doubt that Mr. Britton's idea of having a gas engineering course at the University is a good thing, and that it is bound to be a success; in fact, it is a success today. The six lectures which I was privileged to read to the students last year were received with such attention and enthusiasm that as I looked into the faces of those young men as they were listening to my remarks, I felt as though I was the best paid man at the University of California. I received my reward for every lecture, in the interest and appreciation of those young men. The lectures were attended by large audiences, including the 18 students in the course of gas engineering, and others from the chemical and mechanical engineering departments of the university. The gas business which is so familiar to us is more or less mysterious to even the students in the mechanical engineering department at this great university. The interest was so great that these young men gave up their holidays and worked overtime and visited the different gas works around the bay, put on overalls and jumpers, and learned the practical side of the business. They took hold of the generator valves and operated, and we found that in order to satisfy the minds that were reaching out for new ideas that some of the old boys in the game had to review their early lessons. It became a study for us who were trying to help these boys to answer their questions and start them off on the right track. I feel today that we are accomplishing a great work. We owe it all to Mr. John A. Britton for having persisted in starting it and making it possible. I have been a member of this committee for the last five or six years. I have personally stood in the way of the accomplishment of this great purpose. I didn't know enough to see its possibilities, and finally after they took me off as chairman and made it posible for a live man to get in and carry out the scheme, I found that I was entirely mistaken and that Mr. Britton's ideas were right and are today bearing fruit. In years to come the name of John A. Britton will be repeatedly connected with the gas engineering course in the University of California and I don't know of a better monument that a man can have. Granite monuments will waste away from the physical effects of the elements, but such a monument as he has erected for himself will grow and blossom as time goes on.

TRADE NOTES.

The Boicourt Electric Company, Portland, Ore., is installing the electric wiring in the three-story brick building on Sixth street N., belonging to J. M. Jones.

The Pacific Electric Railway Company has let a contract for grading about five miles of right of way between Hawthorne and El Segundo, to Robert Sherer & Company.

Morrison Electric Company, Portland, Ore., has just completed the installation of the "Roughing In" work in the new Carnegie Public Library, built by the Hood River County Library Association at Hood River, Ore.

West Coast Engineering Company has the electrical contract for the electrical equipment of the building to be occupied by the Killiam Stationery & Printing Company, on the northeast corner Fifth and Oak streets, Portland, Ore. The job will all be in conduit and consist of about 500 lights together with 20 motors in the printing department.

The Booth-Kelly Lumber Company, Eugene, Oregon, has commissioned the West Coast Engineering Company, Portland, Ore., to make plans and specifications and make the complete installation of electric power and lighting in their new electric driven sawmill, having a capacity of 250,000 board feet in 10 hr., which is now being erected at Springfield. The installation will consist of motors ranging from two h. p. to 300 h.p. and the total will be about 2500 h.p., including the planing mill. There will be a three unit monorail system installed in the yards for handling lumber, and current for the monorail will be furnished by the use of a 100 kw. motor-generator set. General Electric induction type motors have been purchased for the entire mill. Power will be furnished by the Oregon Power Company.

NEW CATALOGUES.

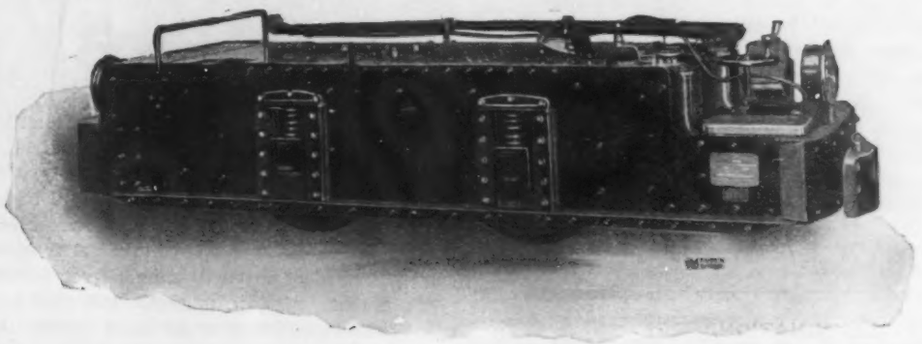
Electric Cooking, "The Berkeley Way," is the title of an illustrated booklet just issued by the Berkeley Electric Cooker Company, Berkeley, Cal. Those who are interested in this subject will find the booklet well worth writing for.

Farie's patent adjustable electric brackets, portables, reflectors and shades; electric, gas and combination fixtures; fixture parts and fittings are listed in Catalogue No. 22, which is being distributed by the Pacific States Electric Company.

INDUSTRIAL

PIONEER ELECTRIC LOCOMOTIVES IN ALASKA.

What is claimed to be the first electric locomotives ever used in Alaska were placed in service within the past few months for mining operations by the Alaska Treadwell Gold Mining Company at Treadwell, Alaska. This company was incorporated in June, 1889, under the laws of the State of Minnesota for the purpose of taking over the Paris mine and reduction works at Douglas Island, which has been operated since 1882 by the Alaska Mill & Mining Company. The mine is an immense low grade ore proposition, the property being equipped with two mills having a total capacity of 540 stamps, power plants, foundry, cyanide plant, machine shop, saw mill, central hoisting and crushing plant, etc., practically all of which are either operated by electric power or being equipped for electric drive.



Type of Electric Locomotive at the Mines of the Alaska Treadwell Gold Mining Company.

The two initial electric mining locomotives are each of six-ton capacity and are operated on a 500 volt direct current circuit from an overhead trolley. They were manufactured by the General Electric Company and are of the standard outside frame type, in which the side frames are placed outside of the wheels. Each machine is equipped with two type HM-801 motors having ball bearing armatures.

The motors are of the usual series wound type and the controller is of the rheostatic magnetic blowout type. A commutating switch is incorporated in the reverse cylinder, the handle of which has four "on" positions, two for each direction of motion, one with the motors in series and the other with motors in multiple. This system of control, by permitting the motors to be started in multiple, allows them to exert their maximum tractive effort independently, so that the slippage of one motor does not affect the other. With the series connections economy in current consumption is effected while running, for the locomotive will then develop a given drawbar pull with one-half the current required with the motors in multiple, the speed, of course, being reduced in approximately the same ratio.

Some idea of the distance to which the use of electric mining locomotives has now penetrated the far north may be gained when it is stated that the mines at Treadwell are nearly 1000 miles north of Seattle, Wash.

THE LARGEST ELECTRIC HOIST.

The directors of the North Butte Mining Company, in a meeting at Duluth, recently voted to award to the Westinghouse Electric & Manufacturing Company the contract for what will be the largest electric hoist in the two American continents, and one of the largest of its kind in the world. This hoist will be installed on the new Granite Mountain shaft which at present is rapidly approaching the 2900 ft. level.

The hoisting drums, which will be 12 ft. in diameter, will be driven by a direct connected electric motor running at a speed of about 71 revolutions per minute. Power will be supplied to this motor from a motor generator set equipped with a 50-ton fly-wheel to secure elimination of the peaks that would be drawn from the power line during period of starting and acceleration.

Hoisting with this equipment will be done in balance, but the equipment is large enough to take care of unbalanced hoistings. Skips will be provided for handling the ore and each will have a capacity of 7 tons of ore. Round rope 1⅝ in. in diameter will be used and the equipment is designed for a normal rope speed of 2700 ft. per minute with a maximum of 3000 ft. per minute.

The capacity of the hoist will permit 300 tons per hour being hoisted from the 2000 ft. level or 200 tons per hour from the 4000 ft. level.

The system of control and power equalization used will be that commonly known as the Ilgner System, in which a fly-wheel driven by the motor generator set is permitted to give up some of its stored energy to supply the peak load drawn by the hoisting motor.

In order to reduce the fly-wheel losses to a minimum, the fly-wheel will be encased in a smoothly finished steel housing and provided with special type of self-lubricating bearings.

The hoisting motor will be of the type used in steel mills and will be of a very heavy construction. In fact, all of the equipment has been designed with absolute reliability as the paramount consideration. The electrical equipment alone will weigh in excess of 250 tons.

The special safety devices include electrically released brakes, automatic slow-down devices to prevent skip or cage ever going through head sheaves and a special controller to limit the speed when hoisting men.

The hoist motor will have a maximum intermittent rating of 4500 h.p. and the motor generator set will be driven by an induction motor having a continuous normal rating of 1400 h.p. The difference between these ratings represent approximately the amount of energy that will be supplied by the fly-wheel momentarily during starting.

The installation is so designed that the draft of power from the power line will be practically constant throughout any cycle of hoisting.

Some very high economies have been guaranteed on this installation by the manufacturer and its installation will be watched with interest.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—Articles of incorporation of the Garibaldi Water Company have been filed by Chas. J. Schnabel, Newton C. Smith and J. B. Ofner, with capital stock of $15,000.

SANTA ANA, CAL.—The El Camino Water Company has filed articles of incorporation with a capital of $10,000. The object of the corporation is to bore wells and furnish water to its stockholders.

PARKER, ARIZ.—Parker & Colorado River Railway Company is to be the name of a new subsidiary corporation of the Parker Improvement Company. W. H. Tharpe is general manager. The purpose of the new company is to operate an electric railway in Parker and vicinity. Application for a franchise has been made to the board of supervisors.

SEATTLE, WASH.—The strategic dock site on the Renton waterway has been deeded to the Renton Real Estate Company. The company is empowered to operate and deal in gas and oil wells on the land or mine for gold, silver, copper, coal and iron. It is also authorized to deal and construct railroads, electric light plants, telephone and telegraph lines, and furnish light and power, and to deal in waterworks, smelters, foundries, etc. The capital stock of the corporation is $40,000. The incorporators are, Paul W. and Matilda Houser, C. L. and Eliza E. Dixon.

ILLUMINATION.

ALAMEDA, CAL.—Mayor Hugh Craig of Piedmont has asked the city of Alameda to supply Piedmont with light and power.

TACOMA, WASH.—The city council has ordered the installation of luminous arc lights on the principal business streets at a cost of $36,000.

SEATTLE, WASH.—An ordinance has been introduced to empower the lighting department to incur the expenditure necessary for the alteration and reconstruction of the substation at Yesler Way.

SAN FRANCISCO, CAL.—A resolution recommending that the board of public works and the city engineer's office prepare plans for the adequate illumination of those streets upon which municipal lines will be operated was adopted.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation has filed an application with the commission for a certificate of public convenience and necessity to operate under franchises in the city of Pasadena.

BANNING, CAL.—The Banning Gas & Lighting Company has applied to the commission for a certificate of public convenience and necessity for the construction and operation of an electric distributing system in this city.

SANTA MONICA, CAL.—Sealed bids will be received up to December 29th for the installation of ornamental light posts, together with wires, conduits and other appliances necessary for installation of a lighting system on both sides of Fremont avenue.

HUNTINGTON PARK, CAL.—The Los Angeles Gas & Electric Corporation has been granted a 40-year franchise to construct and maintain a system of gas pipe lines with necessary equipment, to supply and distribute natural or artificial gas for light, heat and power purposes in this city.

SEATTLE, WASH.—In competition between the Municipal Lighting Plant and the Puget Sound Traction, Light & Power Company, the contract for the lighting of the county court house was awarded to the traction company, for the reason that they were able to make a lower price than the municipal plant.

SPOKANE, WASH.—Property owners along First avenue between Bernard and Cedar streets have taken out new petitions for the installation of a curb lighting system on this thoroughfare. The petitions have been drafted with the cooperation of Commissioner of Public Utilities C. M. Fassett and provide that at the end of 10 years the lighting system shall become the property of the city.

SALT LAKE CITY, UTAH.—The new Commercial Office and Electric Shop of the Utah Light and Railway Company, on South Main street, opened December 19th, is a convenience which the patrons of this company will greatly appreciate. Heretofore the offices of the company have been at a point quite inaccessible to the public for the payment of bills and the making of applications. The Main-street office has been fitted up at an expense of over $7500 to bring the company's service nearer to the people. Opportunity has also been taken to install a modern Electric Shop where the very latest things electrical will be on display. Following the company's policy of co-operating closely with the local electrical supply dealers, no appliances will be sold at this Shop, but prospective customers will be referred to the various dealers for these supplies. A special feature of the office is the exterior decorative lighting. Over 50,000 candlepower in signs, outline, window, marquee and post lighting render this office "the brightest spot on Main street."

TRANSMISSION.

SEATTLE, WASH.—The Board of Public Works has extended the date for the opening of bids for a steam electric plant from December 26 to January 2, 1914.

TACOMA, WASH.—Persistent rumors are current here that the Chicago, Milwaukee & St. Paul Railroad is behind the acquisition of water rights on the north of the Skokomish River for power producing purposes.

WILLITS, CAL.—The board of supervisors has adopted a resolution of intention to sell an electric power line franchise over certain roads in Mendocino county, this being done on the application of the California Telephone & Light Company.

HELENA, MONT.—A special election to decide whether or not a franchise to furnish electricity for heat, light and power purposes shall be granted the Standard Engineering Company of Seattle, will probably be held the latter part of January.

MOUNTAIN HOME, IDAHO.—Further electric development on the Malad River is under way and a second large plant which will generate 15,000 horsepower will be built early next year by the Idaho Power & Light Company, formerly the Beaver River Company.

KLAMATH FALLS, ORE.—The city of Klamath Falls has received a favorable response from the Department of the Interior relative to the establishment of a power plant in connection with the Klamath reclamation project. The government will furnish the power and build the plant, but the city must finance the proposition.

REDDING, CAL.—The Pitt River Electric Power Company has obtained from the Shasta County Board of Supervisors a franchise granting the right to develop and distribute power in Fall River and Burney valleys. A plant cost-

ing not less that $50,000, capable of generating 1000 h.p. will be erected at Burney Falls. A bond will be furnished as a guarantee that work will be started within four months.

BOISE, IDAHO.—The Idaho-Oregon Light and Power Company, over the control of which majority and minority stockholders of both that company and the Idaho Traction Company have waged war for months, has gone into the hands of a receiver, W. J. Ferris of La Crosse, Wis., who was appointed this week by Judge Frank S. Dietrich of the Federal District Court for Idaho, sitting in this city. The receiverhsip will last, it is understood, until such a time as the bondholders can reach some kind of an agreement or the property is sold at a foreclosure sale.

TELEPHONE AND TELEGRAPH.

PUENTE, CAL.—A new telephone exchange building will be erected in the near future at Puente by the Home Telephone Company. The building and exchange will cost about $15,000.

LOS ANGELES, CAL.—The Willard-Slater Company has been awarded the contract at about $105,000 for the erection of the new building to be erected at 622 South Hill street as the main office for the Pacific Telephone & Telegraph Company. The Baker Iron Works has the structural steel contract at $25,800.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company has authorized an additional expenditure of $60,000 for improvements in Vermont district, $39,900 provided for underground conduits, on Western avenue, between Santa Barbara and Fifty-fourth street, and for underground and aerial cable work in the western portion of the district; $11,400 will be expended for aerial cable work between this city and Glendale, private exchanges to be installed in Rockford and Rosegrove hotels at expenditures of $1330 and $1440, respectively.

SAN FRANCISCO, CAL.—Commissioner Gordon presided at the hearings of the application of the Nevada-California-Oregon Telephone and Telegraph Company for leave to absorb the California and Oregon Telephone Company and the California Northern Telephone and Telegraph Company. Scott Hendricks, president, and W. E. Hills, general manager, of George Wingfield's telephone interests in this State and Nevada, appeared in behalf of the application. Minority stockholders in the California and Oregon Company, which the Wingfield concern is seeking to absorb, oppose the merger. The Nevada-California-Oregon Telephone and Telegraph Company is asking leave to buy the California and Northern for $9174 and the California Northern for $67,299 and to issue bonds for the latter amount and $28,299 additional. The minority stockholders contend that the California and Oregon Company is worth more money. On cross-examination General Manager Hills admitted that the California and Oregon earned more than $13,000 in the last eleven months.

TRANSPORTATION.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has plans under way for the immediate erection of a substation near the corner of First and E streets, San Bernardino. The cost is estimated at $15.000.

SAN FRANCISCO, CAL.—The City Engineer has recommended that power for the Union-street railway be bought from the Pacific Gas and Electric Company at the price paid by the city to this company for current for the Geary-street road.

WENATCHEE, WASH.—Application for a 50-year franchise on Wenatchee streets has been made to the city council by Hyman Harris, a local merchant. who declares he represents Seattle capitalists who want to build an electric interurban line through the Wenatchee valley.

SEATTLE, WASH.—The city of Seattle two years ago ordered its two street car companies to exchange transfers on a fifty per cent basis. The Puget Sound Traction. Light and Power Company agreed readily, but the Seattle, Renton and Southern refused. The case was taken to the Supreme Court, which has now rendered a decision compelling the Seattle, Renton and Southern to issue transfers on the fifty per cent basis.

SANDY, ORE.—Another railroad proposition has been laid before the people of Sandy by the Clakamas Development Company of which E. J. Wilson is president. This company asks for the use of the county road between Boring and Sandy as the roadbed for its track and will connect with the Portland Railway, Light & Power Company at Boring. It will be a gasoline-electric system. The company promises to start construction as soon as a franchise is granted.

OAKLAND, CAL.—Officials of the Western Pacific Railroad agreed at a closed meeting of representatives of the city of Oakland and of the Oakland Commercial Club, recently, that the corporation would expend $1,000,000 in improving its portion of the lease on the western water front within the next three years, in the event that the Council grants it the extension of time it asks to complete its work. An official also stated that the road is preparing to spend $15,000,000 in California.

OAKLAND, CAL.—Officials of the city administration and representatives of the San Francisco-Oakland Terminal Railways Company have made final arrangements regarding the proposed extension of the tracks of the traction company down Washington street to San Pablo avenue in front of the new city hall. As a result of the conference, the city will call for bids for the construction of sufficient track to make the necessary extension, and the traction company will supply the necessary connections at the terminals. The completed tracks will be in full operation within 60 days, at the end of which time the tracks will be leased to the traction company.

WATERWORKS.

SEATTLE, WASH.—The contract for the construction of water mains in Twenty-ninth avenue has been awarded to N. Fiorito & Bros. for $3727.

CENTRALIA, WASH.—The contract for the construction of the gravity water system has been awarded to W. H. Mitchell of Seattle for $124,758.70.

PASADENA, CAL.—The Pasadena Consolidated Water Company has applied for authority to issue 129 shares of stock and a note for $7700 and to use the money realized therefor in plant additions and for refunding indebtedness.

PASADENA, CAL.—Stockholders of the Marengo Water Company, which provides water for the residents of the eastesn part of South Pasadena, are planning to make improvements in the system necessary to furnish fire protection for consumers. New pipes will be laid and other improvements made.

CLIFTON, ARIZ.—The Clifton Water Company is now preparing in co-operation with the city council campaign looking towards the installation of many improvements recently ordered by the state corporation commission to be made by the water company, concerning a system and service here. The changes will include the installation of fire hydrants and the erection of fire stations in prominent places throughout town.

ALPHABETICAL INDEX TO ADVERTISERS

Aluminum Company of America 4
American Bridge Company.....
Benjamin Electric Manufacturing Company.....14
Berkeley Electric Cooker Company.....
Blake Signal & Manufacturing Company.....
Bonestell & Co.....13
Bridgeport Brass Company..... 4
Byrant Electric Company..... 9
Century Electric Company 21
Crocker-Wheeler Company 13
Crouse-Hinds Company .....
Cutler-Hammer Manufacturing Company .....
D. & W. Fuse Company .....
Dearborn Drug & Chemical Works.....13
Edison Storage Battery Supply Company 15
Electric Storage Battery Company.....
Fairbanks, Morse & Co.....16
Fort Wayne Electric Works.....19
General Electric Company..... 20
Habirshaw Wire Company.....
Hemingray Glass Company.....22
Holtzer-Cabot Electric Company, The.....
Hughes & Company, E. C.....13
Hunt, Mirk & Company.....
Indiana Rubber & Insulated Wire Company.....
K-P-E Electric Company.....21
Klein & Sons, Mathias.....22
Leahy Manufacturing Company.....13
Locke Insulator Manufacturing Company..... 4
McGlauflin Manufacturing Company.....13
Moore & Company, Engineers, Chas. C..... 5
National Electric Lamp Association.....
New York Insulated Wire Company.....
L. A. Norris Company..... 3
Ohio Brass Company.....
Okonite Company..... 22
Orangeburg Fibre Conduit.....
Pacific Electric Manufacturing Company.....16
Pacific States Electric Company..... 2
Packard Lamp Works.....
Pelton Water Wheel Company.....13
Pierson, Roeding & Company..... 4
Pittsburg High Voltage Insulator Company, The.....16
Pittsburg Piping & Equipment Company.....22
Schaw-Batcher Company Pipe Works, The.....
Simplex Electric Heating Company.....22
Southern Pacific Company..... 21
Sprague Electric Works..... 21
Standard Underground Cable Company.....22
Union Iron Works.....17
Wagner Electric Manufacturing Company.....
Western Electric Company.....
Western Wood Preserving Company.....
Westinghouse, Church, Kerr & Co.....
Westinghouse Electric & Manufacturing Company.....
Westinghouse Machine Company..... 6
Westinghouse Lamp Company.....
Weston Electrical Instrument Company..... 3

New Books just from the Press
For the Electrician and Engineer

STATIONARY ENGINEERING (complete in three volumes), Third Edition

Volume I. Steam Boilers and Attachments, 393 pages and 126 full-page illustrations, with complete index.....$ 3.50

Volume II. Steam Engines, Heating and Electricity. 360 pages and 124 full-page illustrations, with complete index. 3.50

Volume III. Elevators, Mechanical Refrigeration, and Steam Turbines. 308 pages and 74 illustrations, with complete index 3.50

The complete set of three volumes..... 10.00
Terms: $2.00 with order and $2.00 per month, OR $6.00 CASH.

ONE THOUSAND QUESTIONS WITH ANSWERS for Engineers, Applicants for License and Electricians. By Joseph G. Branch, former member of the Board of Examining Engineers of the City of St. Louis.

Contains questions asked by examining boards for engineer's license and electrician's card. 174 pages and numerous tables. Price 1.50

CONVERSATIONS ON ELECTRICITY

A complete manual, covering the principles of both direct and alternating currents. 254 pages and 70 illustrations.... 2.00

PRACTICAL MATHEMATICS FOR THE ENGINEER AND ELECTRICIAN. By Elmer E. Burns and Joseph G. Branch.

The only book on mathematics written expressly for the operating engineer and electrician. To fully understand alternating currents this book is indispensable. 143 pages, fully illustrated and numerous tables..... 1.00

ELECTRIC WIRING. This book is not a mere compilation of tables, but a real, practical book, fully explaining the principles of electric wiring and installation, containing 304 pages, including 102 illustrations and 21 tables, with a complete digest of the Underwriters' Code and a complete index 2.00

PRACTICAL KINKS, RECIPES AND TABLES.

It is a practical book for the operating man, containing 150 pages, fully illustrated, with 200 useful kinks and 40 tables, with a most complete index. 143 pages..... 1.00

THE ELECTRIC MOTOR AND ITS PRACTICAL OPERATION. By Elmer E. Burns.

A complete practical book, explaining the principles and operation of all kinds of motors. Simple, clear and up to date. 191 pages, 78 illustration and numerous tables.... 1.50

ALTERNATING CURRENTS SIMPLIFIED. By Elmer E. Burns.

All about alternating currents. 200 pages and 100 illustrations 1.50

QUESTIONS AND ANSWERS ON PUMPS AND PUMPING MACHINERY. By W. H. Wakeman.

A complete catechism covering the principles of operation of every kind of pump manufactured. Six hundred questions with complete answers. 200 pages, 110 illustrations.... 1.50

THE SLIDE RULE AND LOGARITHMS SIMPLY EXPLAINED. By J. C. Peebles.

A clear and practical explanation of a most useful device. Price ..... .50

YOU WILL WANT TO COMPLETE YOUR REFERENCE LIBRARY

TECHNICAL BOOK SHOP

RIALTO BLDG., SAN FRANCISCO

MODEL 280, Single Range Portable Voltmeter. (One-quarter Size.)

MODEL 267, Switchboard Ammeter. (One-quarter Size.)

WESTON

Miniature Precision Instruments for Direct Current

A new group of very small Indicating Instruments
COMPACT—ACCURATE—DURABLE—BEAUTIFUL

MODEL 280, Triple Range Portable Volt-Ammeter. (One-quarter Size.)

MODEL 268, Switchboard Volt-Ammeter. Reads Amperes. Press Button for Volts. (One-quarter Size.)

PORTABLE

Voltmeters, Millivoltmeters, Volt-Ammeters, Ammeters, Mil Ammeters are supplied in single, double and triple ranges.

The Volt-Ammeter comprising six instruments in one.

This group also includes BATTERY TESTERS.

SWITCHBOARD

Voltmeters Volt-Ammeters Ammeters Mil-Ammeters

This new line of instruments represents the latest development of the pivoted moving coil, permanent magnet type for low ranges.

The refinement of design and mechanical work in them has been carried to a degree which would appear to be almost impossible of accomplishment, if the results were not evident in the instruments themselves.

They embody characteristics which have made the well-known Weston Standards famous throughout the world.
They are accurate, dead beat and extremely sensitive.
They may be left continuously in circuit at full load without injury and are shielded against the external electrical and magnetic influences of other apparatus in their vicinity.
They are substantially constructed and may be safely sent long distances through the mails and will withstand an extraordinary amount of vibration without injury.
They have the longest scale ever provided in instruments with equal length of pointer.
Each model has been thoroughly tested under the most severe conditions of service and in experiments extending over more than one year.
The portable instruments may be conveniently carried in the coat pocket.
The prices have been established upon so low a scale that any one may possess one or more of these remarkable instruments at moderate cost.
If you cannot obtain the instruments desired from your dealer, write us.
Special models and ranges offer a selection from over 300 different combinations, listed in Bulletin No. 8. Will be mailed upon request.

WESTON ELECTRICAL INSTRUMENT COMPANY, Main Office and Works: NEWARK, N. J.

New York, 114 Liberty St.
Chicago, 1504 Monadnock Block.
Boston, 176 Federal St.
Philadelphia, 342 Mint Arcade.
Birmingham, Brown Marx Bldg.
St. Louis, 915 Olive St.
Denver, 231 15th St.
San Francisco, 682 Mission St.
Cleveland, 1729 E 12th St.
Detroit, 44 Buhl Block.
Montreal, Winnipeg, Vancouver, Calgary } Northern Electric & Mfg. Co.
Toronto, 76 Bay St.
Paris, 12 Rue St. Georges.
London, Audrey House, Ely Place, Holborn.
Berlin, Genest Str. 5, Schoenberg.
Johannesburg, So. Africa, F. Peabody Rice, Standard Bank Buildings, Harrison St.

LOCKE

PORCELAIN INSULATOR No. 298

(IN SAN FRANCISCO STOCK)

Line Voltage	15000	Diameter	5½ inches
Test Voltage	60000	Pin Hole	1 inch
Rain Test	35000	P'k'd Weight	2⅛ lbs.
Leak Distance	7 in.	No. per bbl.	100

The Locke Insulator Mfg. Co.
Victor, N. Y.

PIERSON, ROEDING, & CO.

PACIFIC COAST AGENTS
San Francisco Seattle
Los Angeles Portland

In your specifications for trolley wire specify *"Phono-Electric"* as the wire to use. It means a permanent, reliable overhead construction. It is a wire you can depend upon. Let us send you a copy of our red booklet. It tells about *"Phono-Electric."*

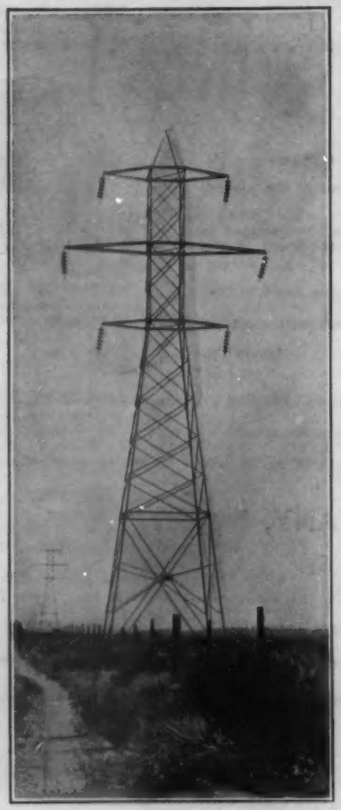
BRIDGEPORT BRASS COMPANY, Bridgeport, Conn.

PIERSON, ROEDING & CO.

PACIFIC COAST AGENTS
San Francisco Seattle
Los Angeles Portland

PIERSON, ROEDING & CO.

ELECTRIC RAILWAY AND TRANSMISSION EQUIPMENT



ALUMINUM WIRE A

USED IN THE GREAT HYDROELECTRIC TRANSMIS

For the transmission of electrical power, ALUMINUM possesses many advantages over other conductors.

Why it is PREFERRED over all other conductors:

Light in weight
Saves in freight charges
Reduces cost of installing, particularly in mountainous countries.
More economic in maintenance cost.

STRONG — DEPENDABLE — EFFICIENT

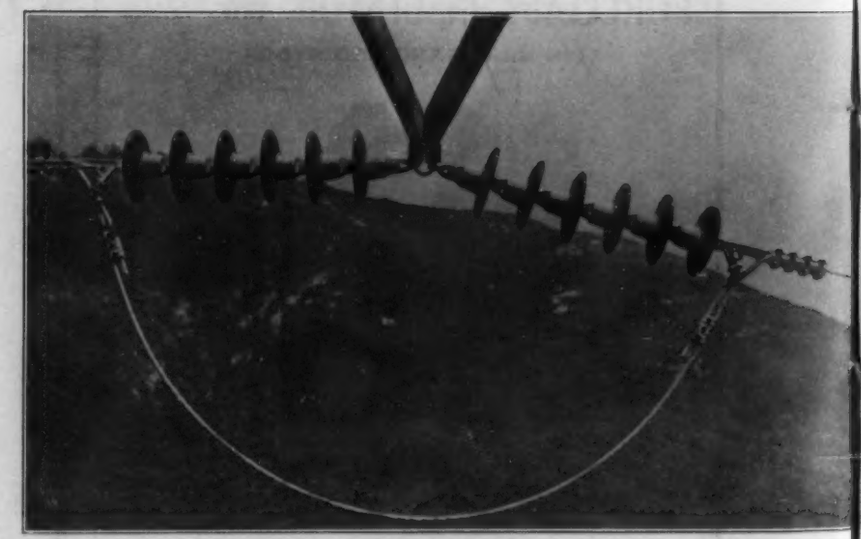
"ALUMINUM CABLE—STE

FOR OVERHEAD

Aluminum Cable, bare or covered with weatherproofed jute or cotton insulation.

FOR UNDERGROUND

Aluminum Cable with paper or rubber insulation covered with lead sheath.



Showing method of dead-ending steel reinforced aluminum cable 110,000-volt steel tower transmission line, using Locke type 2565 insulators.

DESCRIPTIVE CATALOGUES AND FULL INFORMATION FURNISHED ON APPLIC

SAN FRANCISCO, Rialto Bldg. LOS ANGELES, 494 Pacific Electric Bldg. PORTLAND, Spa

PIERSON, ROEDING & CO.

ELECTRIC RAILWAY AND TRANSMISSION EQUIPMENT

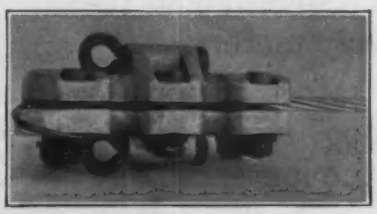
RAND CABLES

TRANSMISSION SYSTEMS OF THE WEST

Among the large power companies of the west using ALUMINUM are:

Southern Sierras Power Co.
British Columbia Electric Railway Co.
Idaho-Oregon Light & Power Co.
Mt. Whitney Power Co.
Northwestern Electric Co.
Pacific Gas & Electric Co.
Pacific Light and Power Corporation
San Joaquin Light & Power Co.
Southern Pacific Co.
Sierra and San Francisco Power Co.
Northern California Power Co.
California-Oregon Power Co.
Southern California Edison Co.

STEEL REINFORCED"

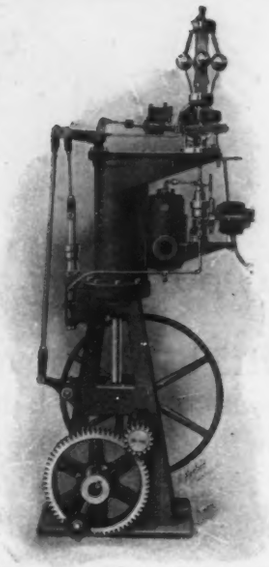


THE DEAD END OR STRAIN CLAMP above shown, is used at the end of a line or at points along the line. It has been designed to give sufficient bearing on the cable to develop its full strength. Eye bolts are provided for attaching it through messenger wire and strain insulators to the pole or cross arm.

APPLICATION TO OUR NEAREST OFFICE

PORTLAND, Spaulding Bldg. **SEATTLE, 523 Colman Bldg.**

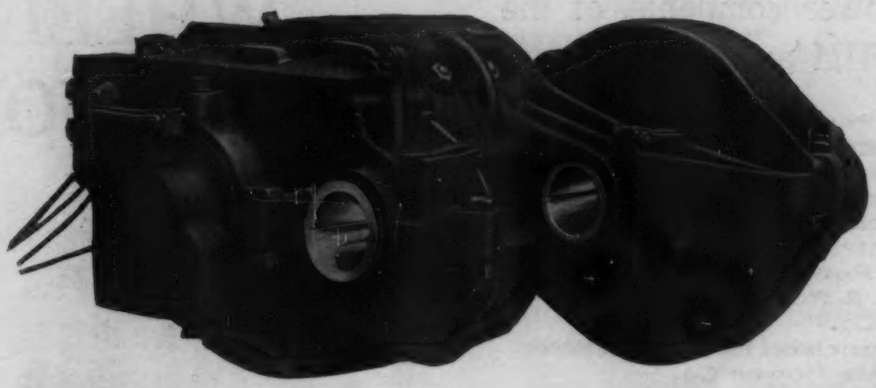
LOMBARD WATER WHEEL GOVERNORS



Water Wheel Governors in 25 standard designs.
Water Wheel Governors of special design for direct connection without the use of gears or other intermediate devices.
Mechanically Operated Relief Valves which are absolutely positive in action.
Governors for Large Steam Engines.
Governors for Large Gas Engines.
Frequency Recorders for switchboard gallery or office use.
Precision Tachometers or Speed Indicators.
Long Distance Speed Indicators for office use.
Speed Recorders.

"The Westinghouse Way"

in railway motor building is to adhere rigidly to the basic features of design and construction which made the famous No. 101-B—



The Pioneer of all Modern Railway Motors

THIS bedrock foundation, together with the logical features incorporated, have given the line of Westinghouse Commutating-Pole Motors their inherent ability to record the most consistently successful performance for economy and reliability ever achieved in the operation of railway motors.

In this age of many developments the safest insurance against the expense and annoyance of a "hoodoo" motor is the knowledge and experience that has produced the long-standing superiority of Westinghouse Railway Motors.

THE REASON WHY the great majority of thinking railway men have but little interest in the particular type number of a motor, and are satisfied if it's a "Westinghouse," is because they have come to appreciate—

"The Motor with a Character"

Westinghouse Electric & Mfg. Company,

Sales Offices in 45 American Cities EAST PITTSBURGH, PA.

PROFESSIONAL DIRECTORY

F. G. Baum & Co.
ENGINEERS AND CONSTRUCTORS
Complete Hydro-Electric Power Developments, Electric Power Transmission Systems, Dams and Irrigation Systems.
1406-8 Chronicle Bldg. San Francisco

G. M. Gest
CONDUIT ENGINEER AND CONTRACTOR
Design and Construct Underground Conduit Systems
San Francisco Office: 503 Market St.
277 Broadway New York City

Sanderson & Porter
ENGINEERS AND CONTRACTORS
Reports, Designs, Construction, Management, Hydroelectric, Railway Light and Power Properties, Oil Pipe Lines.
New York San Francisco

H. M. Byllesby & Co.
ENGINEERS
Chicago, Insurance Ex. Bldg. New York, Trinity Bldg.
Purchase, Finance, Construct and Operate Electric Light, Gas, Street Railway and Water Power Properties.
Examinations and reports.
Utility Securities Bought and Sold

George J. Henry, Jr.
HYDRAULIC AND MECHANICAL ENGINEER
Design and Construction of Hydroelectric Machinery and Specialties
Rialto Bldg. San Francisco

Smith, Emery & Co.
INSPECTING AND TESTING ENGINEERS AND CHEMISTS
651 Howard Street San Francisco

R. F. Chevalier
CONSULTING ENGINEER
Investigation of Power Plants for Fuel Economy Combustion, Boiler and Engine Tests, Analysis of Crude, Fuel and Lubricating Oils. Reports, Estimates, Designs.
729-31 Merchants Exchange Bldg.
SAN FRANCISCO

Hunt, Mirk & Co., Inc.
ENGINEERS and CONTRACTORS
For complete Steam-Electric Power Plants.
141 Second St. San Francisco

Alfred Still
ELECTRICAL ENGINEER
Member A. I. E. E.
Purdue University La Fayette, Ind.

Baum's Alternating Current Calculating Device for mechanically calculating the regulation of a Generator, Transformer or Transmission Line or any combination of these. For any load and any power factor. Also for making synchronous motor calculations. Designed and copyrighted by F. G. Baum
Price $1.00. For sale by TECHNICAL BOOK SHOP Rialto Bldg., San Francisco

D. C. & Wm. B. Jackson
ENGINEERS
Chicago Harris Trust Bldg. Boston 84 State Street
Plans, Specifications, Supervision of Construction, General Superintendence and Management, Examinations and Reports Financial Investigations and Rate Adjustments

Rudolph W. Van Norden
CONSULTING ENGINEER
Member American Institute of Electrical Engineers, Member American Society of Civil Engineers, Reports, Evaluations, Power Development.
Rialto Bldg. San Francisco

John S. Eastwood, C. E.
Designer of dams of the
EASTWOOD MULTIPLE ARCH TYPE
Suitable for any height or site.
Cheaper than earth dams.
Stronger than solid masonry.
Builder of the HUME LAKE DAM.
Hearst Bldg. San Francisco, Cal.

McMeen and Miller
(Incorporated.)
Samuel G. McMeen Kempster B. Miller
Leigh S. Keith
ELECTRICAL AND MECHANICAL ENGINEERS
1454 Monadnock Block Chicago

J. G. White Engineering Corporation
ENGINEERING CONSTRUCTION FINANCING
Alaska Commercial Building
San Francisco
New York Chicago

Ford, Bacon & Davis
ENGINEERS
58 Sutter Street
San Francisco
New York New Orleans

A NEW EDITION OF MANIFOLD & POOLE'S
STRAIGHT LINE ENGINEERING DIAGRAMS
Comprising 44 computing charts, is now ready. These are permanently bound in book form as the series has been completed. Full explanations and examples have been added.
Price $3.00 --- at TECHNICAL BOOK SHOP

AMERICAN DISTRICT STEAM COMPANY
ENGINEERS
Thirty-six years devoted exclusively to the designing and construction of
CENTRAL STATION HEATING PLANTS
REPORTS—PLANS—SPECIFICATIONS
HIGH GRADE STEAM SPECIALTIES
General Offices and Works
NORTH TONAWANDA, N. Y.
First National Bank Building, Chicago
Hoge Building, Seattle

ALPHABETICAL INDEX TO ADVERTISERS

Berkeley Electric Cooker Co.....20
Bonestell & Company..... 11
Bridgeport Brass Company..... 4
Byron Jackson Iron Works, Inc..... 17
Century Electric Company..... 16
Connecticut Telephone and Electric Company .....
Crocker-Wheeler Company 15
Crouse-Hinds Company..... 17
Cutler-Hammer Manufacturing Company..... 14
Dearborn Drug & Chemical Works.....11
Edison Storage Battery Supply Company 11
Electric Storage Battery Company.....13
Fairbanks, Morse & Co.....
Fort Wayne Electric Works.....
General Electric Company..... 18-19
Habirshaw Wire Company.....
Hemingray Glass Company.....13
Holtzer-Cabot Electric Company, The..... 8
Hughes & Company, E. C.....11
Hunt, Mirk & Company.....
Indiana Rubber & Insulated Wire Company.....13
Johns-Manville Company, H. W.....15
Kellogg Switchboard & Supply Company..... 15
Kelman Electric Company .....
Klein & Sons, Mathias.....20
Leahy Manufacturing Company.....
Locke Insulator Manufacturing Company..... 4
Lombard Governor Company.....
Mannesmannrohren-Werke .....
McGlauflin Manufacturing Company.....
Moore & Company, Engineers, Chas. C.....14
Okonite Company 20
Ohio Brass Company..... 12
Pacific Electric Manufacturing Company.....16
Pacific States Electric Company..... 2
Pelton Water Wheel Company.....11
Pierson, Roeding & Company.....4-5
Pittsburg High Voltage Insulator Company, The.....16
Pittsburg Piping & Equipment Company.....20
Schaw-Batcher Company Pipe Works, The..... 15
Simplex Electric Heating Company..... 8
Southern Pacific Company.....13
Sprague Electric Works.....20
Standard Underground Cable Company..... 20
Wagner Electric Manufacturing Company..... 12
Western Electric Company.....
Western Wood Preserving Company.....
Westinghouse, Church, Kerr & Co.....
Westinghouse Lamp Company .....
Westinghouse Electric & Manufacturing Company..... 6
Westinghouse Machine Company .....
Weston Electrical Instrument Company..... 3

IRON HOUR SERVICE

Do you realize that Simplex supremacy has come from its years of reliable service?

That this company has sold **SERVICE**, not guarantees?

That its great success has not developed from printer's ink; but from meritorious product?

Do you know that the faith in the integrity of electric heating devices is based on years of service given by Simplex products?

Do you know that 90 per cent of the irons in laundries and manufacturing establishments (where 2000 to 3000 hours' work must be given every year) are Simplex?

Do you know that one year at such service equals the requirements of **ten years** of domestic service?

If you realize that our best references are those who have used Simplex irons for ten years or more in their business—who have used their equipment 30,000 hours and more—you can understand the value of

SIMPLEX

IRON HOUR SERVICE

Simplex Electric Heating Co.
612 Howard Street, San Francisco

Chicago, 15-21 S. Desplaines St. Cambridge, Mass. Belleville, Ont.

Manufacturers of Everything for Electric Cooking and Heating

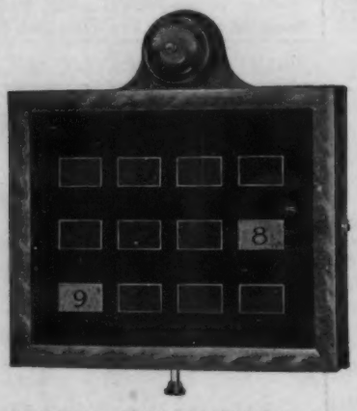
Have you received your copy of the new range booklet? It points the way to freedom from kitchen drudgery and will bring good business to you.

ANNUNCIATORS

We are Specialists in Annunciators.

We build them for the finest buildings in the country.

If you require a special finish or a particular design we can furnish it.



Standard Types, sizes and finishes in stock at all times.

Send for Bulletin 150J

TELEPHONE ELECTRIC EQUIPMENT CO.
PACIFIC COAST AGENTS FOR
THE HOLTZER-CABOT ELECTRIC CO.
BOSTON and CHICAGO

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressors
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V." Electric Agencies Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Converters
Wagner Electric Mfg. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Crocker-Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. Co.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Economy Electric Co.
San Francisco, 444 Market

Edison Storage Battery Supply Co.
San Francisco, 818 Mission.

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So

Hemingray Glass Co.
San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
Berkeley Fireless Cooker Co.
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Fairbanks, Morse & Co.
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor," Pierson, Roeding & Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
Fairbanks, Morse & Co.
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis, R. R. Poppleton, W. M. Crocker-Wheeler Co.
Price Co., A. T. Egan.
Fairbanks, Morse & Co.
General Electric Co.
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Mannesmannrohren-Werke
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Boiler Feed
Fairbanks, Morse & Co.

Pumps, Centrifugal
Byron Jackson Iron Works.
Fairbanks, Morse & Co.

Pumps, Deep Well
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Vacuum
Simonds Machinery Co.

Push Buttons
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.

Reflectors
Holophane Works of G. E. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg
Seattle, 1002 1st Ave (South)

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 807 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco, 57[illegible] Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Mannesmannrohren-Werke
San Francisco, Rialto Bldg.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Ohio Brass Co.
San Francisco, 523 Mission.
Los Angeles, 372 Pac. Elec. Bldg.
Seattle, 524 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
San Francisco, Monadnock Bldg

Poppleton, R. R
20 N. 12th St., Portland, Ore.

Post Co., The Frederick
San Francisco, 135 Second

Price Co., W. Montelius
Seattle, Wash.

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer.
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Pacific States Electric Co.
Pass & Seymour.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill," Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.
Switches, Push Button
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Tubes and Bushings
Ohio Brass Company
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun'a and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 630 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Wagner Electric Mfg. Co.
San Francisco, Rialto Bldg.
Western Electric Co.
San Francisco, 630 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas & Elec. Bldg.
Los Angeles, 811 I. N. Van Nuys Bldg.
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 339 Pacific Bldg
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 161 Market

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—2 72 x 18 return tubelar boilers, brick yard type, 150 h.p. each, Hartford inspection 100 lbs. 2 Alma water tube marine boilers, 150 h.p.; tested 500 lbs.; cold water. Reynolds Electric Co., 310 1st Ave., So., Seattle, Wash.

PELTON WHEELS

have been developed on the Pacific Coast and through their reliability and efficiency, have become the standard impulse wheel of the world. We make the only Pelton wheel

THE PELTON WATER WHEEL CO.
2219 Harrison Street, San Francisco
85 West Street, New York

Because it is the Best it is the Cheapest

Sterling Roofing

We have the sole agency for Sterling Roofing and can recommend it for permanency where roof is exposed to exceptional conditions. It will add distinction and ornamentation to your buildings.

BONESTELL & CO., Agents
118 FIRST STREET - SAN FRANCISCO

ENGINEER'S FIELD BOOKS

for Transit, Level or General Field Notes. 160 pages, 4½ x 7½ in. strongly bound in stiff sheepskin with title stamped on cover.

Price 50 cents each plus postage

TECHNICAL BOOK SHOP
RIALTO BUILDING SAN FRANCISCO

EDISON BATTERIES—EFFICIENT—CONSTANT—DURABLE

Edison Storage Battery Supply Co.

E. M. Cutting, Manager
California District

Office and Supply Rooms
818 Mission St., San Francisco
Telephone Sutter 4438

Dearborn Chemical Company

Manufacturers of Water Treating Preparations to prevent scale, corrosion, pitting and foaming in Steam Boilers

General Offices, Laboratories, and Works: Chicago
948 East Second St., Los Angeles, Cal. 250-254 Front St., San Francisco, Cal.

E. C. HUGHES, PRESIDENT ADOLPH MEESE, SECRETARY

E. C. HUGHES CO.

PRINTERS -- ENGRAVERS -- BOOKBINDERS

LET US FIGURE ON YOUR CATALOGUE AND OTHER PRINTED MATTER

Printers and Binders of the Journal of Electricity and other Publications

147 to 151 Minna Street, San Francisco. Phone Kearny 806

TRANSFORMERS

ACTUAL PERFORMANCE

vs.

EXPECTED PERFORMANCE

FOR the past six months our Commercial Department has tabulated **the actual test results on every transformer manufactured by us.** These tests show better than our guarantees.

WE are prepared to furnish transformers, equal to or better in performance than any transformer on the market. **WAGNER TRANSFORMERS** are rated conservatively. Features such as the patented one or interchangeability of ratio are worth of special attention.

OUR district offices will give prompt heed to any summons from transformer purchasers.

Bulletin 905 at your service.

Wagner Electric Manufacturing Company, Saint Louis

2214

The Effect —
Always a tight joint at "A" when installed.

The Cause —
O-B Lock Hanger—Patent Applied For. Note spring washer inside shell.

A Simple Solution

To get a tight joint between trolley hanger and ear at "A" some linemen have put a spring washer around the stud outside the hanger.

This method reduced the number of threads engaging the ear, increased the bending leverage on the stud and necessitated handling loose washers.

O-B Lock Hanger

Has the same spring washer but inside the shell.

All the advantages but none of the faults of the old method.

Details on pages 97-98 of Catalog No. 12.

HOLABIRD-REYNOLDS CO., San Francisco
R. D. HOLABIRD, Los Angeles, California Agents for
The Ohio Brass Co., Mansfield, Ohio

Quoted from *Scientific American*, May 3, 1913

"A breakdown even of a few moments in the electric power plant which supplies a large city with current for lighting, running elevators and so forth, will not only cause great inconvenience and annoyance, but may in a crowded theatre, for example, bring panic and disaster in its train."

Such a statement proves the advisability of using Emergency Batteries. For this service the "Exide" Battery has been proved to give results. Eleven prominent Central Stations use 30 "Exide" Batteries, having a total capacity at the emergency rate of 94,111 K. W. Reliability of service from "Exide" protection means satisfied customers and more business.

THE ELECTRIC STORAGE BATTERY CO.

New York Boston PHILADELPHIA, PA. Chicago Denver
St. Louis Cleveland Atlanta 1888-1913 Detroit Toronto

PACIFIC COAST SELLING AGENTS
Pierson, Roeding & Co., San Francisco, Los Angeles, Portland and Seattle

HEMINGRAY
HIGH EFFICIENCY INSULATORS

You may not know it, but it is a fact that these are the most successful high efficiency insulators yet devised. **See the Teats on the Petticoats,** they prevent creeping of moisture.

HEMINGRAY GLASS CO.
Covington, Ky., and Muncie, Ind.

REPRESENTED ON THE PACIFIC COAST BY

Electric Appliance Co., San Francisco
Frank Darling & Co., Vancouver, B. C., Canada
Pacific States Electric Co., Los Angeles
Fobes Supply Co., Portland, Oregon

OVERLAND LIMITED
Extra Fare

Train DeLuxe

Southern Pacific—Union Pacific—Chicago & North Western

TO CHICAGO DAILY
IN 63½ HOURS

From San Francisco (Ferry Station) 4:00 p. m.
From Oakland (Sixteenth St. Station) 4:38 p. m.
Arrive Chicago (North Western Station) 9:30 a. m.
(3rd Morning)

New All-Steel Equipment—Electric Lighted

Barber Shop — Manicuring
Shower Bath — Hairdressing
Valet Service — Stenographer
Massage — Stock and
Ladies' Maid — News Report

Observation Car—Ladies' Parlor—Library
Buffet Clubroom Car—Dining Car
Drawingrooms Compartments Suites of three or more Rooms
FIRST-CLASS TICKETS ONLY.

Connecting with Limited Trains of Eastern Lines arriving New York fourth morning out of San Francisco

SOUTHERN PACIFIC

SAN FRANCISCO:

Flood Building, Palace Hotel, Ferry Station.	Phone Kearny 3160
Third and Townsend Streets Station	Phone Kearny 180
U. P. R. R., 42 Powell St.	Phone Sutter 2940
C. & N. W. Ry., 878 Market St.	Phone Kearny 3735

OAKLAND:

Thirteenth Street and Broadway	Phone Oakland 162
Sixteenth Street Station	Phone Lakeside 1420
First Street Station	Phone Oakland 7960

INDIANA RUBBER AND INSULATED WIRE CO.

Manufacturers of

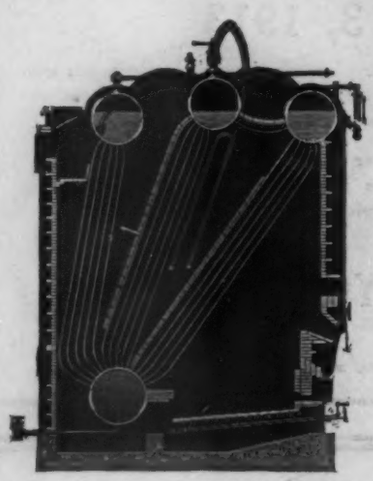
Paranite and Peerless
Rubber Covered Wire and Cables

Underground, Aerial, Submarine and inside use

Telephone, Telegraph and Fire Alarm Cables

ALL WIRES ARE TESTED AT FACTORY, JONESBORO, IND.

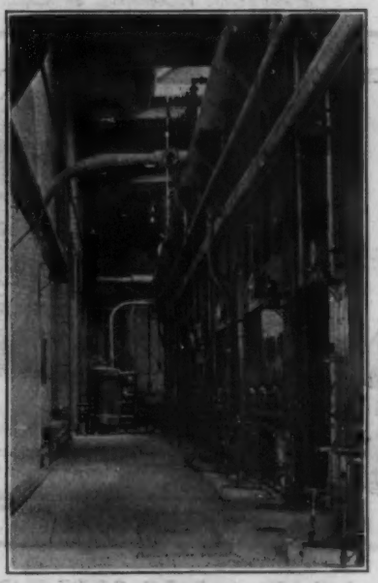
Electric Appliance Company
728 Mission St., San Francisco, Pacific Coast Agents



3500 HORSEPOWER

of

these ← **BOILERS** in this →



Boiler Room of San Bernardino Steam Plant

Southern Sierras Power Company

The boilers, auxiliaries and construction in this plant were furnished by us. The plant was built as an auxiliary and standby for the Southern Sierras Company's extensive hydroelectric system. The fact that STIRLING BOILERS were adopted shows the confidence of the engineers in their service performances.

THIS IS ONLY ONE

of the many plants we have installed in this and foreign countries. Our wide experience in this line has put us in a position to be of service to you. Let us figure on your next job. We furnish

COMPLETE POWER PLANT EQUIPMENT

Power, Lighting, Mining
Pumping, Industrial
High Grade Machinery

CHAS. C. MOORE & CO. ENGINEERS

Information and catalogues at nearest office

San Francisco, First Street
Los Angeles, Van Nuys Building
Seattle, Mutual Life Building
Portland, Spaulding Building
Salt Lake City, Kearns Builning
New York City, Fulton Building
Tucson, Santa Rita Hotel Building

"NOARK"

Enclosed Fuses

Are substantial in construction, neat in appearance, reliable and safe in operation. They automatically indicate when blown. Being "National Electrical Code Standard," "Noark" Fuses are interchangeable.

Comparative tests are invited.

Write Nearest Branch for Catalog No. 406.

H.W. Johns-Manville Co.

NOARK ENCLOSED FUSE

2nd and Howard Sts., San Francisco, Cal.
222-224 N. Los Angeles St., Los Angeles, Cal.
1020 First Avenue South, Seattle, Wash.
OFFICE AND WAREHOUSE IN EVERY LARGE CITY. 1812

The Schaw-Batcher Co. Pipe Works

(INCORPORATED)

Manufacturers of **RIVETED IRON AND STEEL PIPE**

Tanks of all descriptions for Water, Oil and Gas. Single and Double Well Casing

OUR SPECIALTY: Riveted Pipe for High Pressure

Engineers and Contractors for the complete installation of Pipe Lines used in the operation of Hydraulic Mines, Power Plants, Water Works, Irrigation, Reclamation, etc. We have special facilities for supplying general supplies for Mills, Mines, etc.

Office, 211 to 219 J Street **Works, 15th and B Streets**

SACRAMENTO, CAL.

San Francisco Office, 356 Market St. **New York Office, 65 Reade St.**

Motors For All Purposes There is a Crocker-Wheeler Motor for every kind of work. We will gladly advise you as to the best apparatus for your particular requirements. Estimates cheerfully and promptly furnished. The complete Crocker-Wheeler line of motors, generators and transformers is described in illustrated booklet J.

A copy will go to you by return mail if you write today.

Offices in All Principal Cities **Crocker-Wheeler Co.,** Ampere, N. J.

As a "chain is no stronger than its weakest link" no telephone talking or ringing circuit is better than its contacts. Our telephones have PURE PLATINUM CONTACTS which cannot be affected by electric sparks—perfect connection is assured. Write for our bulletins.

KELLOGG

SWITCHBOARD AND SUPPLY COMPANY

MAIN OFFICE: CHICAGO

COAST BRANCH

88 FIRST ST. SAN FRANCISCO

A HIGH TENSION SWITCH

which combines

Reliability Durability Simplicity

Type 866 Weatherproof Oil Switch

This switch is the development of a type now in successful use by the Southern Sierras Power Company and represents the highest phase of high tension switch building. It has

One piece welded steel tank **Weatherproof Case**

One piece moving contact **No wood parts**

It can be equipped with automatic overload release and with remote solenoid control. The price is as low as is consistent with good workmanship and material.

Made for 33, 66, and 110 Kilovolt systems.

Bulletin 800 containing prices and description sent on request.

Pacific Electric Manufacturing Company

"High Tension Specialties"

SAN FRANCISCO CALIFORNIA

WHEN STORMS ARISE → **YOU MAY RELY**

upon your transmission lines if they are equipped with

"Pittsburg" INSULATORS

Our system of tests and inspection is so efficient and thoroughly equipped that we guarantee every "Pittsburg." Whenever you need insulators think of "Pittsburgs."

Pittsburg High Voltage Insulator Co.

Main Office and Factory: Derry, Pa.

New York Office, 114 Liberty St. St. Louis Office, 301 South 7th St.
Seattle Office, 115 Prefontain St. San Fancisco Office, 247 Minna St.
Los Angeles Office, 120 S. Los Angeles St.

Invincible

Split Phase Motors

are offered with the assurance that the purchaser will receive a motor which is correctly rated whether purchased direct from us or connected to any of the various classes of apparatus to which they are regularly attached by manufacturers.

1/20 to 1/4 H. P. 25 to 140 cycles
Clutchless and Clutch Types

CENTURY ELECTRIC CO.

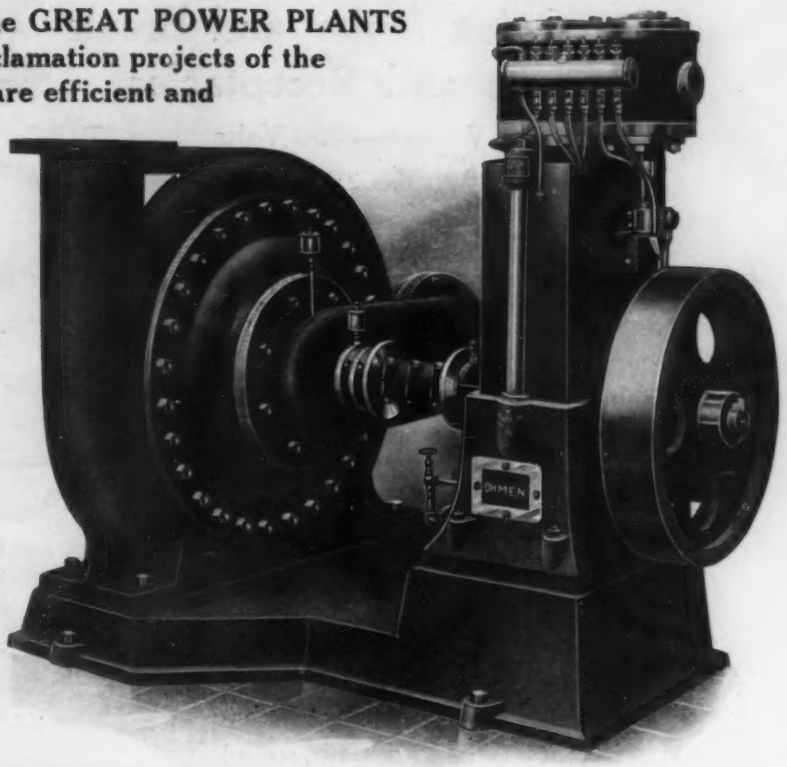
19th and Olive Sts., St. Louis, Mo.

Western Sales Offices and Stocks at San Francisco, Los Angeles, Portland, Seattle, Spokane, Salt Lake City

JACKSON HORIZONTAL DOUBLE SUCTION CENTRIFUGAL PUMPS (10-inch)

AS CIRCULATING UNITS in the GREAT POWER PLANTS central stations, irrigation and reclamation projects of the west, cut the cost of installation; are efficient and constant in operation, the most economical in running expense.

Made for direct connection to vertical and horizontal engines or motors.



Write for estimates and figures and Catalogue No. 35, which will show you where our centrifugal pumps can make a saving for you.

BYRON JACKSON IRON WORKS, Inc.

San Francisco - 357-361 Market Street
Los Angeles 212 North Los Angeles Street
Works - - West Berkeley, California

Type S with Pony Receptacle (Broken-away view)

Type S A

Type S L with Blank Cover

Type S C with Clamp Receptacle

Type S T with Clamp Receptacle

Type S X with Clamp Plug Receptacle

Pony and Clamp Receptacles

are especially provided for by

S Series Condulets

Six Types for as Many Conduit Needs
Each Type Made in ½, ¾ and 1-inch Sizes

There's a Special Condulet for each Conduit Outlet Requirement—All Shown in Condulet Bulletins Nos. 100 and 101. Copies Free. Use Coupon when Writing.

Crouse-Hinds Company

SYRACUSE, N. Y., U. S. A.

CHICACO
CINCINNATI
NEW YORK
BOSTON

Kindly mail me Condulet Bulletins Nos. 100 and 101

Name .....
Street .....
City ..... State .....

9713

This Trade Mark The Guarantee of Excellence on Goods Electrical

G-E Quick Make and Break Sockets and Receptacles

660 Watts — 250 Volts

N. E. C. S.

G-E Quick Make and Break Sockets and Receptacles fill a long-felt want for a *key* socket that can be used interchangeably with keyless socket and switch control, where electric heating devices and other small portables are used on lighting circuits.

This new socket has two breaks in series and makes and breaks with a quick, positive snap.

Simplicity and extreme durability are the salient features of the new mechanism. The movement is not an experiment. It has been perfected and subjected to the most rigorous tests before being placed on the market.

The quick make and break interior has been designed so that it is interchangeable in all Multi-Catch and Fluted Catch socket and receptacle shells. It can, therefore, be readily adapted to installations already made.

Send for a sample today. Tear out this advertisement, write your name and business address on the margin and mail it, or send us a postal card or letter giving your business address. Your sample will be forwarded by return mail.

Examine this socket for yourself. Write now, Wiring Supply Department, G-E Company, Schenectady, N. Y.

G-E Wiring Devices are for sale by all leading jobbers of electrical material.

General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

3995

The Trade Mark of the Largest Electrical Manufacturer in The World.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

Motors Built to Meet Engineers' Recommendations

Mechanically Perfect Frames. — The core punchings of G-E Types K and M Riveted Frame Induction Motors are clamped under heavy hydraulic pressure and held by strong end flanges, making a compact and mechanically perfect unit frame structure. This construction exposes the laminations directly to the air, avoiding "air pockets" and facilitating heat radiation.

Bearing Brackets Accurately Located and Lubrication Dependable. — Cast iron, interchangeable bearing brackets provide a substantial "end shield" protection for stator coils. The brackets fit into a recess in stator frame and are fastened by heavy cap screws, accurately located by jig drilling, thus assuring accurate alignment, as well as ease in assembly. Long-wearing, readily removable bearing linings, which are softer than shaft prevent scoring in case of overheating. Liberal bearing areas guard against the contingency of heating. Oiling is made dependable by means of heavy rings dipping into large oil reservoirs.

Windings Protected.—Enamelled, cotton-covered wire is used for field windings, giving protection against mechanical abrasion, moisture and withstanding higher potentials than with ordinary double cotton-covered wire. These windings are placed in carefully insulated slots, and are frequently dipped into insulating compounds with intermediate bakings. The result is long life and service reliability. The ability of G-E motors to successfully withstand heat and moisture was a big factor in their selection for operating the Panama Canal.

Efficient Rotors with Excellent Operating Characteristics.—High efficiency and excellent operating characteristics are obtained in the Type K motors by correct design and the use of low resistance "squirrel cage" rotors, carefully constructed, to reduce heating and eliminate starting troubles.

Type M Motors for Starting Under Load.—Where frequent starting under load is required, phase wound Type M motors are used with external resistance connected through heavy slip rings. These motors start with high torque and draw comparatively small amounts of current from the line. As the starting resistance is short-circuited when the rotor is up to speed, these motors give practically the same operating characteristics and efficiency as the squirrel cage or Type K.

Bulletins describing these motors and illustrating applications will be sent on request to the nearest G-E office or motor agency.

General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

4262

The Trade Mark of the Largest Electrical Manufacturer in The World.

"STANDARD"
Varnished Cloth
Lead Covered Cable

insures profitable and continuous operation of light and power transmission systems.

Write our nearest office for estimates and samples.

Standard Underground Cable Co.

PACIFIC COAST DEPT.
SAN FRANCISCO, CAL.
Los Angeles Portland Seattle

OKONITE WIRE

OKONITE
TRADE MARK
REG. U. S. PAT. OFFICE

The STANDARD for RUBBER INSULATION

Okonite Tape, Manson Tape, Candee Weatherproof Wire, Candee (Patented) Potheads.

The Okonite Company

253 BROADWAY, NEW YORK

CENTRAL ELECTRIC CO., Chicago, Ill., General Western Agents
NOVELTY ELECTRIC CO., Philadelphia, Pa. PETTINGELL-ANDREWS CO., Boston, Mass.
F. D. LAWRENCE ELECTRIC CO., Cincinnati, O

WHO will furnish your Piping Equipment?

WHY not leave it to people who do dependable work, satisfactorily?

Let

Pittsburg Piping and Equipment Co.

Show You

THEO F. DREDGE Pacific Coast Representative
Monadnock Bldg., San Francisco

Here is Something Needed

Needed by every Electrician, Electrical Mechanic, Lineman, Signalman, Installer, Repairman, Inspector,

TOOL KIT CONTAINING 7 TOOLS,

each one of superior quality. They are: Klein's 7-inch side-cutting pliers; 4½-inch nickle-plated tweezers; 5-inch nickle-plated scissors; double-bladed knife, screw-driver and wire-scraper combined; 3-inch half-round mill file; "Champion" screw-driver and 2-foot boxwood rule.

If your jobber cannot supply you, write us.

MATHIAS KLEIN & SONS
Canal Station Chicago, Ill.

Electric Cooking
with the
Berkeley Auto-Electric Cooker

Heat conservation has been carried much further in this cooker than is usually the case, consequently cost of operation is low. With it you can cook at a cost

AS CHEAP AS COAL OR GAS

The cooling takes place in a thoroughly insulated steam oven kept at constant temperature by an automatic device. This device is absolutely dependable, having been successfully used for five years.

Illustrated, descriptive booklet on request

Berkeley Electric Cooker Co.

"Clean—Convenient—Efficient—Durable"

1932 Center Street Berkeley, Cal.

INSIST ON

Hot Galvanized Rust Proof **TRADE BX MARK** Flexible Steel Armored

AND YOU ARE SURE OF OBTAINING

A CABLE THAT COMBINES

THE EXPERIENCE OF

14 YEARS SUCCESS

Twin Conductors Type BX

MAXIMUM SERVICE VALUE

Ask for Conduit Catalogue No. 43954

SPRAGUE ELECTRIC

SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY

MAIN OFFICE
527-531 West 34th Street, New York
San Francisco, Rialto Bldg. Seattle, Colman Bldg.

LRBAp'14 DEC 27 1950